

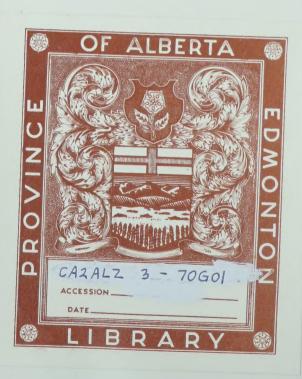
BERTA GOVERNMENT COMMITTEE REPORT

GOV DOC

ON

GREAT CANADIAN OIL SANDS OIL SPILL TO ATHABASCA RIVER JUNE 6, 1970

CA2ALZ 3 70G01



ALBERTA GOVERNMENT COMMITTEE REPORT

ON

GREAT CANADIAN OIL SANDS OIL SPILL TO ATHABASCA RIVER, JUNE 6, 1970

Committee Chairman - H. L. Hogge
Director
Division of Environmental Health
Department of Health

- R. J. Allman
 Pipe Line Engineer
 Pipe Line Division
 Department of Mines and Minerals
- M. J. Paetz
 Chief Fishery Biologist
 Fish and Wildlife Division
 Department of Lands and Forests
- R. E. Bailey
 Director
 Water Resources Division
 Department of Agriculture
- E. E. Kupchanko
 Head
 Water Pollution Control Section
 Division of Environmental Health
 Department of Health

#7885 #A.

DEL LO LUIL DE LE L'ELLINA EL DIDENTE ESTAS EL ELLAWAC S

Compared the cook

STATE OF THE PARTY OF THE PARTY

Chromatal ton growth to sensitive and

RESERVE LA COMPANIA DE LA COMPANIA DEL COMPANIA DE LA COMPANIA DEL COMPANIA DE LA COMPANIA DE LA

CONTENTS

	Page
INTRODUCTION	1
CIRCUMSTANCES OF THE OIL SPILL	2
BEHAVIOR OF OIL ON THE RIVER	3
JOINT ACTION BY COMPANY AND GOVERNMENT OFFICIALS	4
ADVERSE EFFECTS	4
GOVERNMENT SUPERVISION OF PIPELINES	5
FINANCIAL IMPLICATIONS OF THE OIL SPILL	5
CONTROL OF ADVERSE EFFECTS OF OIL SPILLS	8
CLEAN-UP AND CONTROL OF OIL ON SURFACE WATERS	9
SUMMARY	10

INDIVIDUAL REPORTS BY COMMITTEE MEMBERS
REPRESENTING THE FOLLOWING DEPARTMENTS ARE ATTACHED:

DEPARTMENT OF MINES AND MINERALS

DEPARTMENT OF LANDS AND FORESTS

DEPARTMENT OF AGRICULTURE

DEPARTMENT OF HEALTH

Man Calling and a

AND AND SET OF THE PERSON TO

CHIEF THE SO ITS SC MOTURES

TOTAL THE CHANGE A ROLLIN LAND

STORES PERSONS

FINE WILL BY CO. EN PRINTED TO BOOK AS VOO

Breat the Three Cartering as the laws

THE PLAN SON ALL STREET, STREET, SEE TO TO TO THE

The state of the s

A Stantage

THE FATTER OF THE STREET OF TH

prepared of the season of the season of

STERMING THAT STAY I BE LEGISLAND WHEN

Restrict this ham views down and at versal

UNIVERSITY OF THE PARTY OF THE

COMMITTEE REPORT ON OIL SPILL GREAT CANADIAN OIL SANDS LIMITED JUNE 1970

INTRODUCTION

The committee has reviewed the Great Canadian Oil Sands company's oil spill as to cause, effect, and also as to any lessons that may be learned from this particular incident. The report is our evaluation and assessment of the areas deemed to be most significant. Detailed work was carried out by the Departments of Lands and Forests, Mines and Minerals, and Health immediately after the oil spill occurred and this work continued until the direct problems were over. Summaries of this work have been prepared by the members of the committee and are attached. In addition, extensive liaison work with the company was carried out by the staff of these departments, particularly with regard to clean-up and control work on the river and lake. The company was consistently co-operative and receptive to requests and discussions, and made considerable effort to advise the government of their proposed actions. This combined co-operative work was extensive and complete in the continuing assessment of problems during the emergency and made significant progress to control critical areas and avoided mistakes which might have accentuated critical items. During the emergency, recognition of sincere efforts and the practical progress being made are often not recognized.

ALTE THE METERS IN ANTENNE PART CITEMAN SOLD ON MARCHAR PART

to the boundary

CIRCUMSTANCES OF THE OIL SPILL

The oil spill resulted from a failure of the pipeline carrying the synthetic crude oil produced by the Great Canadian Oil Sands
Limited plant to the pipeline system at Edmonton, some 266 miles away.

The break occurred at a wrinkle in a side bend of the pipe where the pipeline changed direction. It consisted of a split in the pipe wall longitudinally some 36 inches long, opening to 4 inches wide at the centre. The failure was investigated in detail and determined to be a construction defect contrary to the construction standards approved by the Department of Mines and Minerals. There was no indication that this was anything more than an isolated and single construction shortcoming, however it is recommended that consideration be given to have this aspect reviewed and assessed.

The sequence of events at the time of the break may be summarized as follows:

- (1) Pressure fluctuations at the pump station noted at 1:45 p.m., June 6th.
- (2) Leak located by 6:00 p.m., June 6th, by aircraft patrol.
- (3) Completion of an earth dam on the drainage course to the river and a diversion ditch over to the plant's sand tailings pond by 9:45 p.m., June 6th.

The pipeline break occurred approximately one and a half miles south of the processing plant and at that point the pipeline is one-half mile west of the Athabasca River. No accurate estimate of the amount of oil that reached the Athabasca River can be made.

Digitized by the Internet Archive in 2021 with funding from Legislative Assembly of Alberta - Alberta Legislature Library

However, Great Canadian Oil Sands Limited has estimated that 19,123 barrels of oil were lost from the pipeline. Appreciable quantities did reach the river and were visible down to Lake Athabasca, some 150 miles downstream. The oil was also visible in certain sections of the west end of the lake for approximately six days.

The pipeline was constructed in 1965 and 1966 and has been in actual operation for some three years. At the time of the break the pipeline was carrying oil at the rate of 51,600 barrels per day (2,150 barrels per hour) at a pump station pressure of 1410 p.s.i. This was within the approved design of 57,000 barrels per day and 1440 p.s.i.

BEHAVIOR OF OIL ON THE RIVER

The oil was carried down the river quite quickly. In two days it was carried approximately 90 miles down the river, mainly along the westerly bank of the river. In the next two days the oil proceeded down to the delta area and the oil started to be noticeable in Lake Athabasca three days later (June 13th). During the next five to six days oil continued to be visible in the westerly portion of Lake Athabasca, however by June 20th essentially all noticeable evidence of oil had disappeared, both from the river and the lake.

The oil was noticeable mainly as an iridescent sheen, particularly visible from aircraft surveillance checks. At times oil in an emulsified state covered portions of the river and accumulated in a few backwater areas in definite layers. Only limited amounts of the emulsified oil, or oil layers were detected in the lake.

downwar, from I can find the first the significant context of the state of the significant of the state of the significant of the state of the state

mi need and box 3 per offs of sold and box bare in sold and box bare in sold and box in sold and a fixer of the break that sold and a fixer and a fixe

The of was certified from the days of the target and the companies of the

The asl was notineable maint on the contract of the city vinetable from educated absolute of the city vinetable of the city of

JOINT ACTION BY COMPANY AND GOVERNMENT OFFICIALS

Covernment officials were advised of the incident during the evening of June 6th and the company worked in close co-operation with the government during clean-up and surveillance programs. The Provincial Government departments most actively involved were the Pipe Line Division, Department of Mines and Minerals; Fish and Wildlife Division, Department of Lands and Forests; and the Division of Environmental Health, Department of Health. It is noted also that the Canadian Wildlife Service and the Federal Department of Indian Affairs and Northern Development were active in the surveillance, control and clean-up operations at a later date. The reports prepared by the members of this committee indicate the assessments made, but do not include the detailed work that was done between the staff members and the company directly as the clean-up and control work proceeded.

ADVERSE EFFECTS

The adverse effects on fish and wildlife, and other uses of the river were not extensive. Noticeable oil did not persist in the river and lake for more than two weeks.

The most marked effects were the following:

- (1) Use of the river as a source of water supply by the communities at Fort MacKay and Fort Chipewyan.
- (2) Interruption of commercial fishing in the area near the junction of the river and Lake Athabasca.

Possible effects on fish and wildlife were studied quite closely and no evidence of actual adverse effects were observed, except a beaver that had become oil covered which caused apparent

and the property of the same at the same

Coverage, of initials were may, and of the invident during the evening of in.

The povernment suring and mineralisance or area. The provincial tree, departments not mineralisance or area. The provincial tree, departments not may actively involved were the Pibe Lin. This was sent of Mine and Minerals Fleb and Mils.

Tife D.V. commine of Lards are force a and the Division of Africe D.V. commines of Lards are force as and the Division of Africe D.V. commines of the sent of Lards are sent to energy Department of Lards and the Canas. Africe S. The sent of Lards are sent of Lards and the control of the sent of Lards are sent of the supported tree control of the sent of the sent of the sent of the control of

E-A---

The v-rm ecros fish on wholsto, and okrea west ? the river con: ' where is the rest in the rest of the river and loke a more than two messa.

the most married all situ were the following:

(1) The of the saver as a source of valor ourgily by the enterminaties at fort Mackey and Fort Olipsupen.

Interruption of commercial fishing in a creative site of starses.

distress and the beaver was killed by the observer.

Lasting or long-term effects will be checked further, however at this time there is no indication that there is any continuing type of adverse effect.

GOVERNMENT SUPERVISION OF PIPELINES

Oil pipelines in Alberta are under the jurisdiction of the Department of Mines and Minerals. There are specific standards for the design, construction, and testing of pipelines. The operation of pipelines is also kept under review, as is the requirement of safety precautions by the pipeline companies. In addition the safety standards are reviewed twice yearly by a nationwide government - industry committee, and the Department of Mines and Minerals is represented on this committee.

It is noted that in 1969 there were some 8,300 miles of pipelines in Alberta and 340 million barrels of oil and oil products were carried. The frequency of pipeline breaks is low and many of these are caused by dirt moving equipment, and other causes not associated with pipeline design or construction factors. Failures of the type experienced in this pipeline break occur very rarely.

FINANCIAL IMPLICATIONS OF THE OIL SPILL

The escape of oil to surface waters could in some cases cause damages having both direct and indirect financial loss. In the case of the Athabasca River oil spill, these damages and financial implications are summarized as follows:

1. Community Water Supply

The effect at Fort MacKay as to the use of the Athabasca River for household water was minimal as the company delivered water

navieses ent to folly and towned but has

issting in long-term effects will be abeard faction, however at the time there is no indication that there is sorthwing type of saverse effect.

SOV INTER SUPERIN SIDE OF PURSUE NOS

Of pipelines in Alberto tre which the northine itenses of the Department of Mines and Minescals, There are saifly itenses in the denigr, construction and testing for elines in the safety pipelines in Miss terminal continuation of the construction of the construction

If it note; note: some were a ment of considering in Alberta, and some of the considering water of the and some some of considering water carrier. The irreguency consequences and or carrier of these are carrier of units morning equitorish, and or carrier of the with processes are carrier of the plant of the constant of the carrier and the plant of the carrier and the plant, as the course, resely.

THOUSEN POTENTIONS OF THE OIL SOLL

Ine enough of oil to dyrisce waters could in come again added the could be supposed that the could be supposed to the cou

to the community. In addition, some members of the community normally use other surface water or well water as a source, particularly when the Athabasca River is muddy during high summer flows. At Fort Chipewyan, Lake Athabasca is the traditional source of water and during the few days that oil was present in this area, other sources had to be sought. A few residents use water wells and some buildings have water intake pipes out into the lake, however these were not affected. The extent of inconvenience or extra cost in this regard was nominal due to the short period of time that the oil was present.

2. Commercial Fishing

The commercial fishing in the westerly end of Lake Athabasca was scheduled for a seven weeks' season this year, that is

May 11th to June 30th. Due to ice conditions the fishing did

not get under way until May 30th. The fishing was stopped for

ten days, June 10th - 20th, but the scheduled open season was

extended to July 15th. This would compensate to some extent for

the interruption, but not fully as some of the prime season

was missed. Also the high flood flows in the Athabasca River

from about June 20th on, which brought a great deal of debris

into Lake Athabasca, interfered with good fish harvesting.

Thus there was a significant loss of revenue to those engaged

in this commercial fishing operation due to the oil spill.

Sport fishing is minimal in the area affected. Thus, the short

period of effect, and the fact that fish were apparently not

directly affected would make any sport fishing loss quite small.

to the community. In addition, were emphased the the community normally were curried waver or well mater as a source.

Buttleuterly were the Athabased Bruce VI muddy during high summer flows. At Fore Chinesyan, Less Athabased is the traditional source of waver and orthogene set days that all was breaked in this area, more sources and to be accepte. A few residents and water we as and the buildings have water tradeens and water these or an acceptant when the extent of the extent of the conventance or exist out of this regard was needed at the total of the extent of the conventance or exist out that the off of present.

Comercial Problem

the commercial fishing in the westerl and of lower Atherena west and west and west and the commercial course of the control of the course of t

3. Alberta Government Supervision

The Alberta Government departments which have jurisdiction or responsibility in the assessment, supervision or control of the pipeline and the oil spill all carry extensive programs. The reports of these departments indicate the nature and extent of the special work done on this project. This extra work was assumed immediately and as a supervisory responsibility. In some instances the departments incurred costs over and above those which are normally incurred.

4. Federal Government Work

The Canadian Wildlife Service and the Department of Indian

Affairs and Northern Development were active in the assessment

of adverse effects on fish and wildlife, the efforts to control

the travel of oil and the removal of oil, particularly in the

area within Wood Buffalo National Park. The possible movement

of oil to the north via Riviere des Rochers and the Slave River

also received attention. Some of this work was undertaken

directly and some was proceeded with as a 'task force' with

Dr. D. Stephen of the Canadian Wildlife Service as the leader.

This task force was set up on the weekend of June 13 and 14,

with discussions between the Department of Indian Affairs and

Northern Development, the Alberta Department of Lands and

Forests and Great Canadian Oil Sands Limited. The task force

was active for a relatively short period only as the oil was

not noticeable after June 20th.

The committee notes that there have been certain statements made that Great Canadian Oil Sands Limited would be held

Modeline Constituted from the total of

The Alberta Coveriment denarthmenta weigh howe particularly responsibility in the successor. Supervision or content of the other star the bulk opinit all carry extensive progress. The reports of these departments indicate the nature and extent of the special work done on this project. This extra work was accumed these ate / sha as a supervisory responsitive. It is the instance ate / sha as a supervisory responsibility. I shall have the appropriate orders that and above than their normally incurred coars.

From statement Work

I e abbot will will be envice and the uncommons of loaked in the addresses. It sates a circuit on the articles of a sates and it sates a circuit on the articles of a sates and it e rame) of all and the removal of all particularly in the area which in the list and the removal of all particularly in the area which in the list of a half fork. The possible covernment of the if the interest of the considerable all of the area and area from the area of this work was undertaken as a try and an area of the considerable of the area of the leaders and the leader. This case from was at decoder with as a 'task from a sate from the weakend of June 13 and 13, with discussions between the long or the weakend of June 13 and 13, with discussions between the long that a constitute of lands and greaters and discussions between the longerthesis of lands and greaters and discussions between the longerthesis of lands and greaters and discussions between and Sands bimitted. The

financially responsible for expenses incurred in connection with the oil spill. Notwithstanding this, the company participated actively with the task force and was appreciative of assistance given to them.

CONTROL OF ADVERSE EFFECTS OF OIL SPILLS

Normally, the extent of adverse effects would vary directly as to the volume and extent of travel of the oil, and also whether or not it reaches a body of surface water. The committee has considered each of these aspects for the purpose of assessing potential ways and means of minimizing the adverse effect of any future incident.

1. Reduction of Loss of Oil

The loss of oil by drainage through a pipeline break may be significant in certain types of terrain. Current practice is to locate block valves and check valves at strategic locations to minimize the loss of oil from breaks.

Of prime importance, however, is early detection of a pipeline break. Specific rate of flow detectors at each end of the pipeline, suitably co-ordinated and connected to an alarm warning system, particularly on the larger diameter and longer pipelines could assist in this regard.

2. Extent of Travel

This will depend on the volume of oil released, the nature of the terrain and the ability to construct retaining berms or impoundments. Early detection is again important.

Staurdielly responsible for expensing thin, the commany nextletwith the old will. Notestabling thin, the commany nextletmated extively with the task force and was appreciative of
assistance wires to them.

CONTROL F ADVENUE REPORT OF OUR STELLAR

Normally, the extent of we are either a would very directly as

to be volume and extent of travel of the ..., and class or or

not trace at a body of surface water. The numbited has copaidared

each there are or ... o surproce of asserting potential ways

needs of bit minter of adverse either of any future inches?.

The long of our constructe through a sipeline preck only he can exact the construction of terrain. Corrent precises in the content of the second of the construction of the construction of the construction.

If wime appears nowever, is early defection of a pipeling breet. Seeif - rate of flow netocross at each end of the niceline, cuiteble co-ordinated and connected to an alors warring system, corticularly on the larger stameter and longer could not still recept.

in the Jon gett

3. Protection of Surface Water

Current standards require additional pipeline safety factors at all river crossings. Consideration should be given to the extension of this to areas adjacent to rivers, e.g. within one mile. The benefit of this would be most significant near larger rivers and where the ground slopes definitely to the river.

CLEAN-UP AND CONTROL OF OIL ON SURFACE WATERS

This aspect is dealt with quite fully in the Department of Health's report and the committee would summarize as follows:

On lakes and other bodies of water the oil spread is relatively slow. Recovery and removal of the oil would be feasible if suitable equipment and staff were available. Early action would be important as strong winds could spread the oil so that recovery would be difficult and adverse effects augmented.

On streams and rivers the travel and spread of oil is relatively rapid. Rivers in prairie land, away from steep sloped mountains and foothills will be flowing at a velocity of some two to four feet per second (32.7 to 65.4 miles per day) most of the year. Any oil reaching the river is carried with the water and recovery is difficult because of the extensive spreading of the oil and the fast movement of the water and oil. Specialized techniques would be required to make significant recoveries of oil. Clean-up operations also would be difficult because of the length of travel and rugged terrain along the banks.

1. Protecting of version there

Ourrest standards require odd. . . pipeline catery factors at all river procurings. Consideration should be given to the extension of this to erset adjocent to rivers, e.g. which are mile. The benefit of this would be most significant user increase as increased above definitely to the river.

CLEAN-UP AND CURPRED OF SEE OF SUPPACE VACERS

This eagent is dealt with quite filly is the Demarkment of Heelth - tenert con the country with the selections:

of luxes and their indices of water the selections of luxes and theorem and removal of the selection of the feasible of the sole equipment with the constant of the selection of the selection of the feasible of the lumbrish as single which we constant as single which country winds country appears the selections. The selections would be difficult and altertice of the advancement.

months and rivers the trivel and press of its relatively report. Tivers a graints land away from steep sloped abuntains and from bills will be firstling on a velocity of some two to rour feet per second (32.7 to 65.4 miles per day) most of the year. And oil resching the river is corrided with the tacker and recovery is difficult decause of the entensive ap abiling to the ulter of the entensive ap abiling the time of the entensive apabiling to the ulter and cit. Special to the ulter of the united of the category and cit. Special to the united of the united of the category and cit. Special to the united of the un

the tree to the terms of the te

Because of the nature and complexity of clean-up and control operations, it is recommended that the oil industry and pipeline companies be requested to consider the organization of a joint program for this purpose. The need for speedy action at the time of a spill is extremely important, and this is essentially dependent on the availability of suitable equipment and knowledgeable staff.

It would be helpful to have an official Government committee designated for the purpose of assisting with, and supervising clean-up and control operations of any future incident of this nature. The Government committee could work with the joint group in the planning stages and also in operational work.

SUMMARY

The adverse effects of this oil spill were relatively small.

Nuisance effects were minimal because of the relatively sparse settlement and development of the affected area. Fish, waterfowl, and river biota effects were studied closely and found to be negligible. For a short time, adverse effects were experienced in commercial fishing and in obtaining water at two communities. Long term effects will be checked for, but there is no indication that these will be noticeable.

Canadian Oil Sands Limited immediately after the oil spill occurred and were continued until completed. The most effective one was

Property of the case and carelerity of eigen-up and control operty one, it is constrained that the organization of a joint careful to be requested to consider the organization of a joint control for this purpose, the certification at the control for this purpose, the certification at the control for this certification and the certification of and the control of a certification of antitable equipment and known test of a certification of antitable equipment and known test and known.

Selections and a selection of a sold by eroment are the selection of the s

YMANEGIA

In the second offers were minimal remains of the relatively reads.

Second of the relatively of the effects and the relatively opened and rever the refers were about the electron of the effects were about the conservation of the electrons and found to be conservable. The above time advices electrons and found to be conservable front of the object of the object of the object of the conservation of the co

A TOTAL WARREST AND A

the early diversion of escaping oil to a pond, thus preventing its continued flow to the river, and the use of booms to prevent the spread of oil to lake areas in the delta area. Work to remove oil from the river was not very successful due to the thin film of oil on the river and the rapid flow of the river. Accumulation of oil to a definite layer occurred in some backwater sections of the river, but these were often located in remote areas and lasted for only a short period of time. The use of chemical dispersants was limited because of possible interference with the removal of oil work and the possible increase in a toxic hazard to fish, general water biota, and to household water use.

Extensive surveillance and assessment work was done by the company and by agencies of the Provincial and Federal Governments. The company maintained an open door to suggestions and requests, and kept the agencies advised of their work, problems and progress.

The committee's review of this incident has included the assessment of ways and means of prevention, control and restoration. This has been difficult; significant improvements have to be practical, not just theoretical. Probably one of the most important suggestions is the one recommending additional instrumentation of pipeline flow to give early detection of a pipeline break. We must recognize the extreme difficulty of removing oil from a flowing river or controlling the spreading of the oil. Specialized equipment and staff, and ready availability of the same, would be expected to make some progress in this difficult area. Preplanning and 'joint' industry and 'joint' government organizations could also be advantageous.

August 12, 1970.

H. L. Hogge,

Committee Chairman.

The card, direction of excepted of to a port, temp provering its consistence flow to the river, and the use of comes to prevent that appears of oil to take error in the delen area. More to remove all from the river was its very entrectable due to the thin film of all on the river and the result how of the river. Ascendiation of all to a deficite was natural occurred in some beninater sentions of the river, but there was natural located in remote areas and leasted for only a sent their period on the river was interfered in remote areas and leasted for only a sent there of possible interferer with the removal of oil years limited because of possible interferer with the removal of oil years tipes.

rient unverticed and adsertment work was fone by the compart and pagencies of the Provincial and Pederal deversors in the rown, maintailing at your pend door to suggestions and requests.

end sept the asserted advised of near work, problems and progress.

con tee's revi of its incident as incident as incided the coresent ment of as and bears of prevention, control and restoration. This lift that after the approximants have to be prestical, not as allowedical throughout the interface that is the one recommending additional insurmentation of missions flow to give asrly detection of a missions brook. We must recomine the other early detection of a missions brook. We must recommend the flow the entire difficulty of removing oil from flowing rivers on 2000.

ADDENDUM - OCTOBER 1, 1970

Item "3" - Alberta Government Supervision - page 7

Further information on this item has been obtained since the report was completed on August 12, 1970. This information is being included here to provide more specific information as to the cost of supervisory or effect assessment by the Provincial Government. Some of these costs also include work closely allied with the clean-up operations, however the largest percentage of the cost is directly associated with the supervisory and control work carried out by the Provincial Government. The committee would mention that this supervisory and control work is undertaken directly, both as part of normal programs, and in the case of unexpected incidents or emergencies.

Department	of Lands and Forests	\$ 4,966.18
Department	of Mines and Minerals	235.21
Department	of Health	1,136.63
Department	of Agriculture	nil
Т	otal	\$ 6,338.02

The committee has also taken advantage of this review opportunity to update the submission by the Department of Agriculture committee member.

The information contained previously was in the form of an interdepartmental memorandum and this has been updated as an item for inclusion in the committee report.

In addition, the initial report has been reviewed in a general way as to improvements which might be made in presenting information directly related to the pipeline break and subsequent oil spill to the Athabasca River.

ADDERABLE COMPERAL 1970

Thems - modeling as not wanted and the first

Firther information is this them can obscized since the paying each commission of majors (2, 1970) bits information is being included here to convide most appealite information as (a see case of supervisory on effect mesons of the second of

P TO TEST E

endate the embrication by it is partitioned of Agriculture constitute member.
The information combarant provincials were in the form of an economic of the large of the large

In particular, the report by the Department of Health was reviewed at some length as the section on "Reflections and Comments" (pages 8 to 15) is mainly general in nature on the subject of 'oil spills' and only indirectly related to the Athabasca River oil spill. This section could be deleted to advantage in keeping the report shorter and to the point. However, the committee felt that the general information may assist by providing background information and by summarizing current technology available. The committee does, however, wish to emphasize that the physical circumstances at the area in which the oil spill occurred must be recognized and evaluated in determining what type of control and clean-up work will be appropriate and effective in that particular case.

Committee Chairman

October 1, 1970.

In part of section we deflective as demonsts (pages 1 to 15)

In matrix section to success or the request of that spills and early interests; related to a Aurabaasa or per spills. Sits section rould be defected to anything to the point. This section was a point. This end to the point. This





Report respecting the break occurring on June 6, 1970 in the oil pipe line of Great Canadian Oil Sands Limited

by

R. J. Allman
Pipe Line Engineer
Department of Mines and Minerals



CONSTRUCTION OF THE PIPE LINE

Great Canadian Oil Sands Limited applied to the

Department of Mines and Minerals for authority under The Pipe

Line Act, 1958, to construct an oil pipe line from its oil

sands plant located some 20 miles north of the town of Fort

McMurray to the terminal of Interprovincial Pipe Line Company

east of Edmonton. The Superintendent of Pipe Lines and his

engineering staff reviewed the design and specifications of

the pipe and installations proposed to be used in constructing

the pipe line and they established that the pipe and installations

proposed were technically satisfactory.

The permit authorizing the construction of the portion of the pipe line from the plant southerly to a point about five miles southeast of Redwater was granted on September 9, 1965 and the permit authorizing the construction of the remainder of the pipe line to the Edmonton terminal was granted on September 23, 1965.

The pipe line was constructed in 1965 and 1966 by Canadian Bechtel Limited. Test procedures were prescribed by the Superintendent of Pipe Lines and upon completion of the construction the pipe line system was hydrostatically tested with water to a static pressure of 125% of the proposed maximum operating pressure. These tests were witnessed and performed to the satisfaction of pipe line inspectors of

TO 08 7.12 32

Acres Carmist II was 120 (Epilonia in a

Department of the same L. or or try

Line Act 1970, to construct

ston traig atmos

McMurray to be Lerellon

east of bineenton.

tinte tultein in in

king prime and knowl

the it. The oad

t tok jesegons

or the with to

ran irine selim

The ages of the space of the property terms by terms of the terms to a static areasure of the property of the property and terms.

9.00

the Department of Mines and Minerals.

On August 22, 1966 a provisional licence was granted under The Pipe Line Act, 1958 to the company for operation of the pipe line. When the plans indicating the surveyed location of the land in which an interest had been acquired for the pipe line were available, the company applied for a licence under the Act and the licence was issued on September 28, 1967 by the Superintendent of Pipe Lines and the licence is still subsisting.

The pipe line is approximately 266 miles long, has an outside diameter of 16 inches, and has wall thicknesses varying from 0.312 inches to 0.203 inches. The pipe installed at the crossings of the Athabasca and the North Saskatchewan Rivers has a wall thickness of 0.500 inches. The pipe line along its entire length is coated, wrapped, and cathodically protected against external corrosion.

The pump station is located at the plant site where the synthetic crude oil is stored after processing. Three mainline pumps are installed in the pump station and are capable of pumping 57,000 barrels of synthetic crude oil a day. The maximum operating pressure for the northerly 24 miles of the pipe line (0.312 inch wall thickness) is 1440 psig, for the next 27.5 miles (0.281 inch wall thickness) is 1315 psig and for the remaining 214.5 miles to the Edmonton terminal (0.203 inch wall thickness) is 950 psig.

the Department of Mines and Minerala.

um August 22, 1965 a pravinjemel licende ver straulad

the pipe line. When the plans indisading he surveyed lession of the sep. If which an interest had sen somired for the pope line were available, as company applied the Act and the linence was same on September 18, 181 by the Euperlandence to filps lives and the incesse is sent

es outside minneter of in thoses, and has the markets warning the crossings of the strategy and the strategy are strategy as the strategy and the strategy are strategy as the strategy are strategy as the strategy and the strategy are strategy as the s

along its entire leasth Ed coated, wracted, and causically protected when P : El F

the synthetic trude oi! .. stored siter endessing, Three maintine pumps are installed in the pump station and era capable of pumping 57,000 barrels of synthetic crude oil a day. The eximt a coreting pressure for the northerly 24 miles of the carting pressure for the northerly 24 miles of the carting pressure for the northerly 24 miles of the carting pressure for the northerly 24 miles of the

PARTICULARS OF BREAK

Mr. D. Burmey telephoned from the plant to Pipe Line Inspector, Mr. D. Knopp, at his home at 12:30 p.m. Sunday, June 7, 1970 but Mr. Knopp was not at home. Mr. Burmey phoned again about 2:00 p.m. as Mr. Knopp was arriving at his home. Mr. Burmey then mentioned that Great Canadian Oil Sands Limited had experienced a break in its pipe line and that the break was at a short distance south of the plant and near the south boundary of the plant site. Mr. Burmey mentioned that the break had occurred the previous afternoon and that only a small amount of oil was escaping from the pipe line. As to the approximate amount of oil, Mr. Burmey said he could not make an estimate. Appreciating that the location was in a forested area Mr. Knopp asked about notification to the Department of Lands and Forests. Mr. Burmey mentioned it had already been reported and employees of the Forestry section and Wildlife section were already at the location and supervising the cleanup operations.

Regarding the oil that had escaped, Mr. Burmey mentioned that a dike had been constructed confining the escaping oil to an area away from the river. As to the recovery of the escaped oil Mr. Burmey did not think this would be possible.

In consultation with the Assistant Superintendent of
Pipe Lines it was decided that Pipe Line Inspector, L. Charbonneau,
would proceed on Monday morning to the location. Mr. Charbonneau

Pegarding the clithat had consped, Mr. Burney newiloned that a disa had ern constructed confining the escaping oil to an area every Trom the river.

The earstwill for Burney die not think this would se possible:

The consultation with the cast Superfit

arrived at 1:00 p.m. finding that repair procedures by the company were under way. The break was located 1.4 miles south of the plant and some 2,000 feet west of the Athabasca River.

A distance of 60 feet on either side of the break was excavated and a 16 foot section containing the fracture was cut out of the pipe line and taken to the company's workshop on the plant site. Following this an additional 44 feet of pipe was removed, being a total of 60 feet.

It was agreed that the 16 foot section of the pipe would be metallurgically inspected. Mr. Charbonneau was satisfied that the cleanup operations that the company had under way in consultation with personnel of the Department of Lands and Forests were appropriate. It seemed unlikely that any of the oil diverted by the dike could be recovered due to its low viscosity.

endirer fore ourse way. The weak was in the Anabuses River,

which exempts the contract that the company of the profession value of the company of the company of the company of the company of the contract of the company of the contract of the company, wing a but of the company.

The constitute of the constitute of the pipe of the pipe of the pipe of the term of the constitute of the constitution of the constitu

REPAIR OF THE BREAK

A section of pipe similar in length to the 60 foot section removed from the pipe line was bent in the shop of Canadian Equipment Sales and Service Co. Ltd. (Cessco) to the extent necessary for suitable alinement in the pipe line. The pipe was hydrostatically tested in the Cessco shop to 1800 psig.

The section of pipe was moved to the location and welded into position. The welds were then 100% radiograph inspected and the repairs were completed on June 10th. The air in the line was purged out, filling operations commenced, and the pipe line resumed operations at 11:00 a.m. Inspector Charbonneau was in attendance and the welding, radiographing, repairing and purging were performed to his satisfaction.

By 3:30 a.m. on June 11th, the line pressure had stabilized to normal pumping pressure conditions of 1050 psig with two mainline pumps delivering a total flow of 1600 barrels of synthetic crude an hour.

A section of migralism value was been in the chop of rection removed through the pipe also was been in the chop of lanedism squipment Tales and Dervice Co. Lto. (Despect to the extent recessory for successful althought in the Caseco and the pipe also also pipe also the pipe as nydrostatically tested in the Caseco and to to the page.

The setten of pice was moved to the local or organization into position. The welds were then 100% positions for integering on the contracted on June 10th. The air in the line was larger out, filling operations concessed, and the pipe line resumed operations at 11:00 a.m. insertion whertcomess we in attendance and the wasaing, resisting, when purging were performed to also satisfaction, by 3:30 a.m. or June 18th, the rare pressure had stabilized as normal susping pressure conditions of 10bu page with two mathiful pumps leaveling at 100 of 1600 harrous of assistant as satisfaction.

OBSERVATIONS REGARDING THE BREAK

The break occurred at a wrinkle in a side bend of the pipe where the pipe line changed direction. This wrinkle was approximately 2 inches wide, projected outwards 2 inches from the normal outside diameter of the pipe, and extended some two-thirds of the distance around the pipe, leaving some 17 inches of pipe not directly affected by the wrinkle. The break consisted of a split in the pipe wall longitudinally along the fusion weld of the pipe some 18 inches on either side of the wrinkle, opening to 4 inches wide at the centre. The configuration of the break was therefore in the form of an elongated diamond.

It appeared that the pipe had been hand wrapped after the wrinkle occurred indicating that a final length of pipe had been installed connecting two sections of the pipe line. However the 16 foot section of the pipe involved in the break has been delivered to Hanson Materials Engineering Ltd. for metallurgical inspection and analysis and its investigation is presently continuing. Additional information in this regard and with respect to internal corrosion may be expected in the final report.

The break can be attributed to a defect in construction.

Middle The Amidentifi 8

The local occurrents at a primary in a sign bend of the pine where the pine that yet the charged direction. This writhing was approximately it haves vide, projected cutwards a income from the normal outsis, connected on no page, and extensive some two-thirds of the distance around the pipe, resping some if they not a nextly affected by the writation; the solit is seen outside one unit longitudinarity.

the confirmmentlon of the break one therefore in the Form of an economic of diamons

line. bowever the 1: Foot relation of the pipe involved is one break has been delivered to Heason Materials diginoraling bid. for metallurgical inspection and analysis and its investigation is presently continuing. Additional information in this regard and with respect to internal corro

man dayed aville





FISH AND WILDLIFE DIVISION DEPARTMENT OF LANDS AND FORESTS

REPORT ON INVESTIGATIONS OF THE FISH AND WILDLIFE DIVISION

INTO THE G. C. O. S. OIL SPILL

IN THE ATHABASCA RIVER SYSTEM, 1970

M. J. Paetz Chief Fishery Biologist

J R 3 to 11 ME ONA METS

REPORT ON 1997 FARATIANS 9 THE EIDS SECTION 1912 197 OFFICE ON S.

INTO 518 G. C. D. S.

IN THE ATMACASCA ALVER SYSTEM.

M. J. Paets Chief Fishery Biologist

REPORT ON INVESTIGATIONS OF THE FISH AND WILDLIFE DIVISION INTO THE G. C. O. S. OIL SPILL IN THE ATHABASCA RIVER SYSTEM, 1970

INTRODUCTION

Investigations into the environmental effects of the oil spill into the Athabasca River in the vicinity of the Great Canadian Oil Sands processing plant were carried out during the period June 6th to 19th by the field officer and scientific staff of the Fish and Wildlife Division. The investigations may be placed in three categories: (a) General observations; (b) Sampling of oil-contaminated waters and bioassays; and (c) Sampling of vertebrates and invertebrates in areas exposed to the spill.

During the course of the investigation the writer was associated with a task force which was charged with the responsibility of coordinating investigations, clean-up operations, and publicity. This task force was headed by Dr. D. Stephen of the Canadian Wildlife Service and its activities will be the subject of a separate report.

GENERAL OBSERVATIONS

Fish and Wildlife Officer A. H. Boggs at Fort McMurray was informed of the pipeline break at 9:25 pm, June 6th. He began observations at the site of the break on the morning of June 7th at which time he conferred with personnel of G. C. O. S. and examined the area between the pipeline break and the path over which the oil spillage travelled en route to the Athabasca River. Also observed was the dyke which had been built at approximately 9:00 pm on June 6th by G. C. O. S. to divert the oil from its course toward the river into a holding pond on the G. C. O. S. lease. Officer Boggs noted that at about 6:00 pm on June 7th straw was

CATTOMS OF THE FIRE AND MERBLISH DIVISION
1906 G. C. O. S. OLK SPILL
CO THE ATHRESCA RIVER SYSTEM. 1970

MODEL CONTROLLED

Investigations into the environmental circula of the old Asill the Athabasca River in the vicinity of the orest Lacquism Oil Sanda processing plant were carried out during the period lune bin to 100 by the field officer and scientific staff of the Fish of Wildlife D. Son. The investigation. How he placed in three categories: (a General observations; (b) Sampling of oil contaminated waters and security of the contaminated waters and security of vertebrairs and security of the contaminated waters and contaminated waters are contaminated waters and contaminated waters and contaminated waters are contaminated waters an

During the course of the investication the writer was on area with a task force which was charged will the responsibility con in a cashing time, clean-up operations, and publicity that itsk torce hadded by Dr. D. Stephen of the Canadian Wildlit Service and its activities will be the subject of a separate concur

CENERAL OBSERVATIONS

Fish and Wildlife Officer A. H. Beggs on Fork McMurray was informed of the pipeline break at 9:25 pm, June Ath. He began observed at the arte of the break on the morning of June 7th at which sime with personnel of G. C. O. S. and samined the area between break and he path over

placed across the drainage stream which carried the oil spill to the river. This straw boom was located on the stream just above its confluence with the Athabasca River and was designed to trap oil which had contaminated the vegetation and land surface below the point of the diversion of the spill into the holding pond.



FIGURE 1. PIPELINE BREAK.





FIGURE 2. POND OF SPILLAGE NEAR PIPELINE BREAK ON PIPELINE RIGHT-OF-WAY.



FIGURE 3. PIPELINE RIGHT-OF-WAY AT POINT OF PIPELINE BREAK. NOTE SPILLAGE TO THE LEFT.





FIGURE 4. DYKE BUILT DIVERTING SPILLAGE.

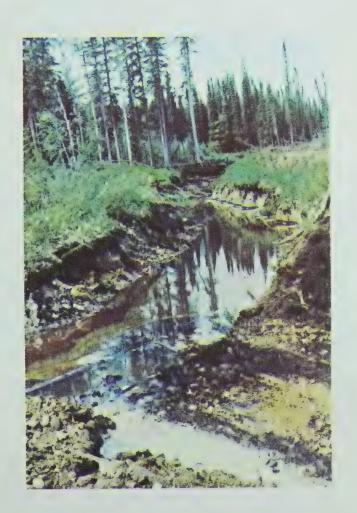


FIGURE 5. COLLECTION OF SPILLAGE BEING DIVERTED BETWEEN BREAK AND ATHABASCARIVER.





FIGURE 6. SPILLAGE DIVERTED INTO HOLDING POND.

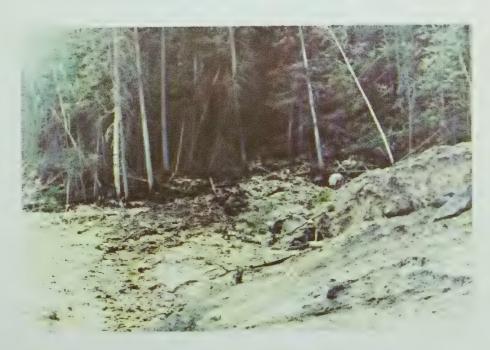


FIGURE 7. TRIBUTARY OF SPILLAGE NEAR THE RIVER BETWEEN THE DIVERSION AND THE ATHABASCA RIVER.





FIGURE 8. POINT WHERE EFFLUENT ENTERED THE ATHA-BASCA RIVER. THIS PHOTO WAS TAKEN AFTER THE SPILLAGE WAS DIVERTED.

On the afternoon of June 8th and on June 9th and 10th patrols were made down the Athabasca River from Fort McMurray to Embarras Portage and a similar patrol was made by the officer at Fort Chipewyan from the mouth of the Athabasca River upstream to the Indian Reserve #201 F. By June 9th oily material was noted on the surface of the river about five miles above the Embarras River and a yellowish curd-like oil emulsion was observed ten miles above the Embarras ranger station. During the upstream patrol, Officer Schaber noted the presence of ducks on the river below the oil-contaminated area but reported a relative absence of these birds after oil was encountered on the river.

On June 14th the writer accompanied Dr. D. Stephen and Captain

Noonan on an aerial patrol of the river and the west end of Lake Athabasca.



The river was observed from an altitude of approximately 300 feet from the G. C. O. S. plant to its mouth as was the delta area and the west portion of Lake Athabasca from Big Point Channel to Fort Chipewyan. arrival at Fort Chipewyan a float-equipped aircraft was chartered to make aerial and surface inspections of the delta area, Fletcher channel and Big Point Channel. Observations made on these trips were as follows. The river from the G. C. O. S. plant site to Bitumont was relatively free of surface oil slick. If an emulsion was present in this stretch of river, it was not discernible from the aircraft. From Bitumont downstream a surface slick of oil was obvious over the entire river and in the main river channels of the delta area. A portion of Richardson Lake (estimated 25 percent of the lake surface) showed an iridescence indicating the presence of a thin surface oil film. Numerous other ponds and small lakes in the delta area showed no contamination with oil, and there was no evidence of contamination on Mamawi Lake or its outlet channel on this date. All that portion of Lake Athabasca south and west of a line from the mouth of Big Point Channel to Fort Chipewyan was covered with a surface oil film and strings of yellowish emulsion were observed in various areas throughout this portion of the lake. This emulsion was also observed along the north shore of Lake Athabasca at Fort Chipewyan.

Observations made by landing a float-equipped aircraft on

Fletcher Channel and Big Point Channel revealed patches of water-oil

emulsion and a thin surface oil film. This surface film was more difficult
to detect at water level than it was from some distance above the water.

On June 19th and 20th the writer and Officers A. H. Boggs and J. I. Doonanco proceeded by boat from Fort McMurray down the Athabasca River and Big Point Channel and across the west end of Lake Athabasca to

Fort Chipewyan. No evidence of a surface oil film was encountered throughout the entire trip and only on rare occasions could evidence of oil adhering to the mud along the shoreline be noted. Similarly no evidence of an oily film or an emulsion was noted crossing the west portion of Lake Athabasca. It appeared that the oil spill had either been assimilated in some way by the river and lake waters so as to render it undetectable by visual observation or it had passed out of that part of the system and down the outlet of Lake Athabasca. It is the writer's opinion that the disappearance of the spill between June 14th and June 19th was due to a combination of the above factors. It is significant to note that a storm from the west occurred during the intervening period which stirred the lake vigorously and dissipated both the surface film and the emulsion.

On June 20th a patrol was made by Dr. D. Stephen and the writer in a helicopter from Fort Chipewyan, along the north shore of Lake Athabasca to Fidler Point. Again no surface oil film or emulsified oil was evident in the lake waters. However, a yellowish scum-like material was observed in isolated pools of water along the sandy beach just west of Fidler Point. A sample of this material was collected for later analysis.

On Jume 21st a return trip by boat was made from Fort Chipewyan to Fort McMurray. It was noted that the river level had risen some two to three feet since Jume 19th and navigation was made somewhat hazardous by the presence of large amounts of floating debris, ie., logs, trees, and trash. No evidence of the oil spill was noted until the mouth of the Firebag River was reached. Here an iridescent film was noticed in large patches on the river surface and a strong smell of oil was detected. This condition was encountered at frequent intervals for the remaining distance to the

To evidence of a overloce oil film was entraved of entraverses of entre entravel evidence of

en substing to the end along the chore'the Ei noted. Similarly no evidence of an ofly film or an equation concentration that the Achtbases. It opposed that the off applies had either been existed of the some way be the viver and take enters an as to render it unreservation and the enters and also asked on all in part if the evena and down the curlet of take Athabasea. It is the inter's coincing that the disappearance of the oppill between land 14th. The 19th was one to a combination of the above factors. It is a nittant to me that a storm from the west occurred both the secreption.

onui. gö

in a hel copter find Nert Chinewysa, mone one more 1219ang to Pidler Point. April o nurface oil film of this and this one of the lake waters. However, limited sermett certief and conserved a isolated pools of water thong the same seach that it Ridler Point.

A sample of this triversal was collected for their malysis.

On June 21st a secure trap of over we area fore that the permanted Port McMurzuv. It was noted that the rayer level had rised some two to feet eince June 19th and nowl gotton was made somewhet nazordaws by eas of large enumin of floating debris, ie., logs, trees, and a cf the oil spill was noted until the mouth of all of the oil spill was noted until the mouth of all of the courts of the court of all of the courts of the court of

if the tasts her Ita in the

G. C. O. S. plant site. Examination of the river at the site where the original spill entered revealed that the fresh sign of oil was due to a rise in the river level which caused flooding some low-lying willow flats. This low-lying area had retained significant amounts of the oil spill but it had not entered the river until the level rose and floated the oil out into the main channel. Company officials were immediately advised of the additional oil contamination source.

SAMPLING OF OIL-CONTAMINATED WATER AND BIOASSAYS

Samples of the oil spill were taken for analyses from the site at which the oil entered the river, from the Athabasca River above the spill, and at various intervals from the plant site down to and including Lake Athabasca. The analyses of most of these samples are included in the section of the report prepared by the Division of Environmental Health and do not require further elaboration here. The results of several samples in addition to those contained in the above report are of interest however. A sample of Athabasca River water 200 yards above the point of entry of the spill on June 10th was found to contain 10 mg/l of oil. This would indicate that there is at certain times a significant amount of oil in the river from sources above the site of the spill. The sample of yellowish scum found on June 20th in beach pools just west of Fidler Point on the north shore of Lake Athabasca contained 17 mg/l of oil and grease. This is a greater value than would be expected from sources such as pollen from the adjacent coniferous forest and may be indicative of some oil reaching this area as a result of the strong west winds which occurred during the period June 14th to 19th. It should be noted, however, that this was not a grab sample of water but rather that it represented a collection mainly of the yellowish

share sites. Exemple that river at the vite where and apill entered revealed that one fresh angules of all was and ke a far the river level which caused fileding some levelwing william Flags.

This ice-lying area had retained ones a consecute of the off spirit has it had not entered the river call that I well rose an filedted the off each the river call that I well rose an filedted the off each distribution of the modifical off the content of the conte

SAME D': OF THE CONTADENATED AT ER VALUE REPAR

Samples of the colored the front to Ath and score to spill, and at various the first to Ath are stone to spill, and at various to spill, and at various to section of the contract of the colored the order of Athebases of the color of the color

material itself which was thus heavily concentrated.

The surface sample taken from the Athabasca River near its junction with the Firebag River on June 21st when a new oil slick was noticed contained 4.2 mg/l of oil and grease. This value is lower than may have been expected considering the oily appearance on the river surface at this point.

Bioassays using rainbow trout as test fish were conducted on the following water samples:

- (1) Water and oil emulsion sample taken June 14th from Fletcher Channel - oil and grease analysis: 323 mg/l. Result - no deaths in 48 hours.
- (2) Surface sample from Fletcher Channel when oil sheen was noted - oil and grease analysis: 35 mg/l.
 Result - no deaths in 48 hours.
- (3) Sample of water and oil emulsion water taken June 14th from area between mouths of Embarras and Fletcher Channels. Oil and grease analysis: 537 mg/l. Result - 50% mortality in 24 hours, 100% mortality in 48 hours.

In addition to the above, bioassays using rainbow trout were conducted on mixtures of G. C. O. S. oil, water, and two dispersants being used by the company to assist in cleaning up the spill. These dispersants were Corexit 7664 and a substance known as Polycomplex A-11.

Results of the bioassays are shown in the following tables.

- was thus heavely concentrated.

The refer sample taken from the Athony-ng River many its a contribution of the Athony-ng River many and the the same of the sa

bicassaya upleg valebew treat ; res filse ware indeced en tha

- (1) Hatter and oil complete semalt administration of the transfer of the complete of the compl
 - (2) Forfige and Tidles in come show about the state of th
- (3) Sample in water of 11 mulain water area land 1815; from area between models (1) heartag and Florithm.

 Channels, 111 as exalivered 537 mg/1.

 Neguli 34 marratty 1 24 hours, 1004 mercality 18
- The addition to the above, blussumes using the best treat weeks.

 I have no of the C. O. S. oil, ester, and the displanation of the suits.

40 mm. m.

Table I. Bioassay Results on G. C. O. S. Oil.

Concentration	Time	Result
50 mg/1	24 hrs 48 hrs 72 hrs 96 hrs	100% survival 50% survival 50% survival 25% survival
25 mg/1	24 hrs 48 hrs 72 hrs	100% survival 50% survival 50% survival

Table II. Bioassay Results on G. C. O. S. Oil plus Polycomplex A-11 (Dispersant)

Concentration	Time	Result
25 mg/l oil 2.5 mg/l Polycomplex A-11	24 hrs 48 hrs 72 hrs 96 hrs	75% survival 50% survival 25% survival 0% survival
25 mg/l oil 5 mg/l Polycomplex A-11	24 hrs 48 hrs 72 hrs 96 hrs	25% survival 25% survival 0% survival 0% survival
50 mg/1 oi1 5 mg/1 Polycomplex A-11	24 hrs 48 hrs 72 hrs 96 hrs	25% survival 0% survival 0% survival 0% survival

Table III. Bioassay Results on G. C. O. S. Oil plus Corexit 7664

Concentration	Time	Result
25 mg/l oil	24 hrs	50% survival
100 mg/l Corexit	48 hrs	50% survival

These tests indicate that concentrations of 25 mg/l of G. C. O. S. oil can be toxic to fish but that the water-oil emulsions formed in the river were considerably less toxic. It is further indicated where concen-

Biomesy Reedla on R. R. D. S. Dil.

for hy so a 2001		1/20 08
favlvaus 308		
25% sumvivel		
Isotrae 2001		25 me/l
	72 1189	

Table 11, Ulnersey Heards; n t u. O. S. Oil plus

The west		Police de la Company de la Com
Iculurum 121 Forturum 202 Levinos 253		25 mg/l Polynospica A-1
ing solving		
interve 's	, ए ४.त	25 mg/l oil 5 mg/l Polycomgles 3-11
Prototra 20		
252 Euruluud NK a r r vol		30 /1 oil 5 1 lolvenumles A-11
	sm di	

Tebre 133. Aleacany Results t. S. C. D. S Oll plus

trations of G. C. O. S. oil of 25 mg/l are reached, Polycomplex A-11 should not be used as a dispersant at the recommended rates of 10:1, oil to dispersant, because of toxicity problems. Insufficient tests were carried out on Corexit 7664 to accurately determine safety levels for fish when using this material as a dispersant. However, it would appear from the tests done that the amount of this product used in treatment of the Athabasca River and Lake Athabasca during the recent spill did not constitute a more serious hazard to fish life than the oil itself.

SAMPLING OF VERTEBRATES AND INVERTEBRATES IN AREAS EXPOSED TO THE SPILL

Fish

The chief concerns regarding the fish fauma of the system as a result of the oil spill were: depletion of fish food organisms, mortality of the fish populations and barring actual mortality, the tainting of commercial fish species with an oily flavor in Lake Athabasca. (A commercial fishery for walleye and pike was in progress in the west portion of the lake at the time of the spill.)

Athabasca, no evidence of such was observed. Pike and walleye were caught by angling on June 19th in the Athabasca River near the entry of the Firebag River; walleyes were being taken regularly near Fort Chipewyan between June 17th and 20th; and pike were caught at the junction of Keane Creek and Big Point Channel on June 21st. All specimens taken were examined and were in good condition.

The sampling of fish food organisms was carried out by use of an Ekmann dredge during the period June 17th to 20th. All samples were preserved and returned to St. Paul for analyses. The presence or absence of

tions of G. G. D. S. ell of 25 mg/l era reached, Pelyramples A-11 incl he used as a diametrant at the recommonded tytes of 10:1.

carried out on Corexit 7664 to accurately problems. Insufficient tosts were carried out on Corexit 7664 to accurately determine safety levels for 715h when using this material as a dispersant. However, it would appear from the tests done that the ancunt of this product used in treatment EE that Athabases River and Luke Athabases during the resent spill did not compared tute a more cortous hazard on fish life than the oil timelf.

SAMPLING OF FREEERICS AND INVESTIGATES

The chief concerns regarding the first laims of the system as a second of the oil spil vere: depletion of Cish food organisms, mortality of the fish nopulations and berring actual mortality, the toforting or commercial fish species with an oily flavor in take Athabases. (A commercial fishery for uslieve and pike was in progress in the vest portion of the lake at the time of the apill.)

With regard to mortality of Itah III the river and in Lake
Athabases, no evidence of such was observed. Pike and wallays were asught
by angling in June 19th in the Athabases II ver near the entry of the
Thinkes Tiver; valleyes were being taken regularly near Fort Chinavian
June 17th and 20th; and pike were caught of the juncti

. And although one of a

te foot dall

oil in bottom materials was also recorded during analysis. A map showing the locations of samples taken to determine presence of invertebrate animals and the analyses of the samples is presented in Appendix I.

Since no sampling of the invertebrates of the area was carried out prior to the oil spill and since little work of this nature has been done in the area at any time in previous years there is no basis for assessing any change that may or may not have occurred as a result of oil contamination. The presence in some of the samples of certain pollution intolerant organisms such as freshwater shrimps, caddis fly larvae, and to a lesser extent mayfly nymphs, is an encouraging sign which suggests that serious depletion of fish food organisms probably did not occur. However, one cannot state changes in aquatic invertebrate populations did not occur in some areas.

As previously stated, a commercial fishery for walleye and pike was in progress in the area of Lake Athabasca, and was affected by the oil spill. Most of the fishing was being done near the delta area and between Goose Island and Fort Chipewyan. When the oil reached the lake there were complaints of oil adhering to the webbing of gill nets and fears were expressed that the presence of oil in the lake may cause an oily flavor in the fish. Since this flavor, if present, would not be detected until the fish had been shipped to points outside the province, agreement was reached between provincial authorities and the fishermen that commercial fishing would cease until tests could be made to determine whether or not the fish were tainted. Fishing was therefore halted on June 10th and tests were carried out during the week of June 14th to 20th to obtain samples of fish for judging impariment of flavor. The locations of the nets to obtain fish are shown on the accompanying map.

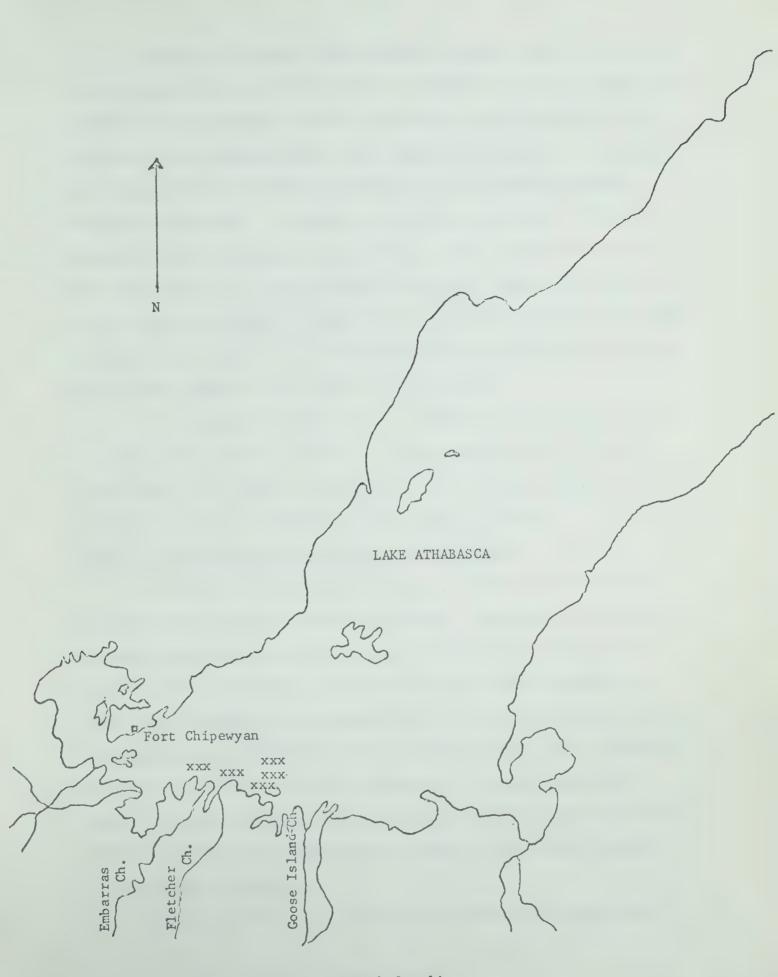
dw berief meserial was also recorded during engines... A non-rewing the Coestains of semples taken to determine presence if towertwhis motions and the snalpers of the samples is presented in '

Since no empling of the invertebrates of he eren was puried out prior to the oil spill are since little form up this nature form in the crea at any time in provious years there ——

secretains any chance that now or may not form among if extern notification content nection. The presence in some of the tonger is a stain notification intolerant organisms such as freshvorth section condition that is a content any overhead it as encourant terms depicted a count of the country of the content organisms and of the minutes proof to a country overhead organisms proof to a country overhead organisms proof to a country of the content and contents of the country of the contents of the country of the contents of the conten

As distributed and a control of the control of the

esseing was therefore haired on June 19th and eg



xxx Locations of Fish Sampling

Chilpery an

5.75 120 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 - 200 Samples of goldeye, lake whitefish, walleye, and pike were sent to the Canada Department of Fisheries in Winnipeg for flavor judgment. The results of this judging, which was carried out on both raw and cooked portions of the various species, were negative with regard to oily flavor and a message to this effect was telephoned to the Fish and Wildlife Division on June 19th. In addition to the fish forwarded to Winnipeg, samples of walleye obtained on June 20th were taste— and odor—tested at Fort Chipewyan by the writer and four other staff members on the same day as the fish were caught. No oily flavor or odor was detected by the panel. A single walleye taken in the Athabasca River near the Firebag cabin was also declared negative with respect to oil tainting.

On the basis of these tests the fishermen were notified on June 21st that commercial fishing on Lake Athabasca could be resumed immediately. At a later date the length of the fishing season was extended in order to compensate for the period of closure.

Effects on Wildlife other than Fish and Invertebrates

During the various trips made by Fish and Wildlife Division personnel into the area affected by the spill, observations were made to determine whether any waterfowl or aquatic mammals were distressed or killed by oil contamination. On June 8th Officer Boggs obtained one beaver along the bank of the Athabasca River, Sec 13-Twp 94-Rge 11-W 4. This animal was not exhibiting normal behavior and was found, upon being killed, to be covered with an oily substance. No other mammals were reported. A member from the Indian Reserve at the delta area reported to a meeting held in Fort Chipewyan on June 14th that he had not observed any ill effects on muskrats.

On June 14th Dr. D. Stephen of the Canadian Wildlife Service

Semples of suldays, lake whiteefish, engliese, and pixa were sent to the Canada Department of Disherden in Winnipeg for flavor judgment. The results of this judghag, which was certical out on both raw our worked portions of the various species, were negative with regard to only flavor and a message to this effect was telephoned; the Fish at Wildlife Dishelon on June 19th. In addition the first terrarded to Wise page earpies of walleye obtained on June 20th area taster and odor-toward at Port Chipewean 51 the writer and four their tails as the fish were caught. No oil flavor or soon was lotecit possel as the fish were caught. No oil flavor or soon was lotecit possel also declared negative with respect to

Iune 2 leu that Locretilas share and seas mulimends stelly. At a late interest the compensate for the calculation order to compensate for the calculation. Wil iid., other than ing and creates

During the vertiers trips came by rise and Mildlin Division perconnel into the area offected on the smill, observations were node to determine whether now waterford at aquatic membels were distresced or lift of by oil contamination. On June Sth Officer Rogs obtained one boaver along the bank of the Athabasia River, Sec 13-Tup Wi-Ree 11-W 5.

This color of the course with an oily subal moe. No other marmals that, to be coursed with an oily subal moe. No other marmals

a source of a son

and the writer observed several species of ducks, shorebirds, and gulls flying into and away from water areas on which a definite oil sheen was noted. These birds did not at that time appear to be adversely affected. No dead or distressed waterfowl were observed on the downstream trip from Fort McMurray to Fort Chipewyan on June 19th and 20th or on the return trip on June 21st.

SUMMARY

This report outlines the observations and activities undertaken by the Fish and Wildlife Division during the oil spill from the Great Canadian Oil Sands pipeline break into the Athabasca River and Lake Athabasca. While the spill was one of considerable magnitude, it appears that immediate damage to fish and wildlife resources in the area was minimal. A combination of relatively high flows and a heavy silt load in the Athabasca River during and shortly after the spill, and the relatively light, volatile nature of the oil in question probably combined to ameliorate the effects of the spillage.

The color of the c

PAMAUT

This ment outlines the observations and exclusives aparets and by the Man Man Man Man Milette Division during the cit spill from all access the Man Milettee backs and a Athebrace River and the Atheresee. While the cities and also are all considerable maps and all agrees a chart temperature during a relatively back from the access that are all the constant the Architecture of relatively back flows and a bear title as an about the cities the cities and about the color are the cities of the cities of the cities probably conditions to

ACKNOWLEDGEMENTS

The author wishes to acknowledge the valuable contributions of the following members of the Fish and Wildlife Division during the investigation: Dr. S. B. Smith, Director: Officers A. H. Boggs, E. Schaber, J. Nichols, N. E. Thomas, and C. W. Scott; Regional Officer J. I. Doonanco; Regional Biologists M. Robertson and F. Bishop; Technicians V. Gillman and J. Allen; and Pollution Research Biologist P. Paetkau.

The leadership of Dr. D. Stephen and the assistance of other members of the Canadian Wildlife Service at Fort Chipewyan and the assistance of Mr. R. Gilmour of the Department of Indian Affairs is also acknowledged.

ACCEPTAGE FOOT WESTER

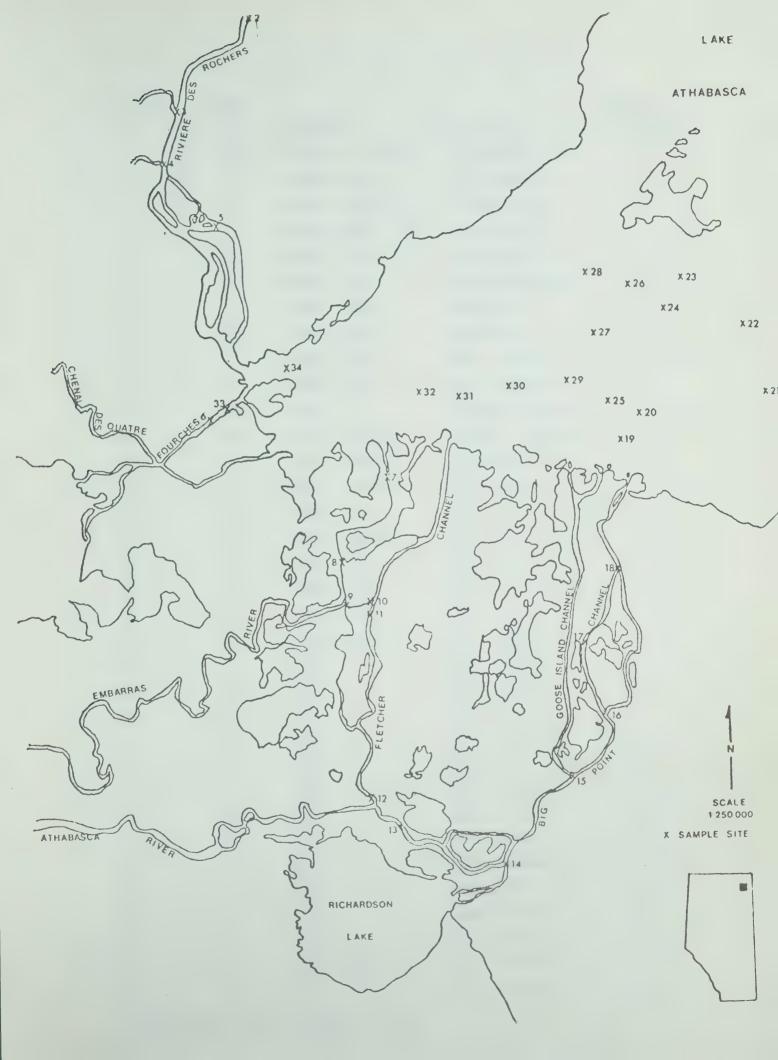
The server wisher is asimmalading the valuable contributions of the Shall sing members of the Fish and wildlife Division during the grown Clympian: Dr. S. B. Smith, director: Officers A. H. Boggs, E. Schabe J. Michels, M. F. Thomas, and C. ... Scott; Regional Officer 1, 1.

Regional Michelster M. Robertson and F. Rishop; Technicians V. Willman and J. Allen; and Robertson and F. Rishop; Technicians V. Willman and J. Allen; and Robertson and F. Rishop; Technicians V. Willman and J. Allen; and Robertson and F. Rishop; Technicians V. Willman and J. Allen; and Robertson and

The leadership of Dr. 1:

members of the Canadian Wildle a Service of Springeryun and the assistance of Mr. E. Gilmon te the Dr. officeat of Afficial advantaged.





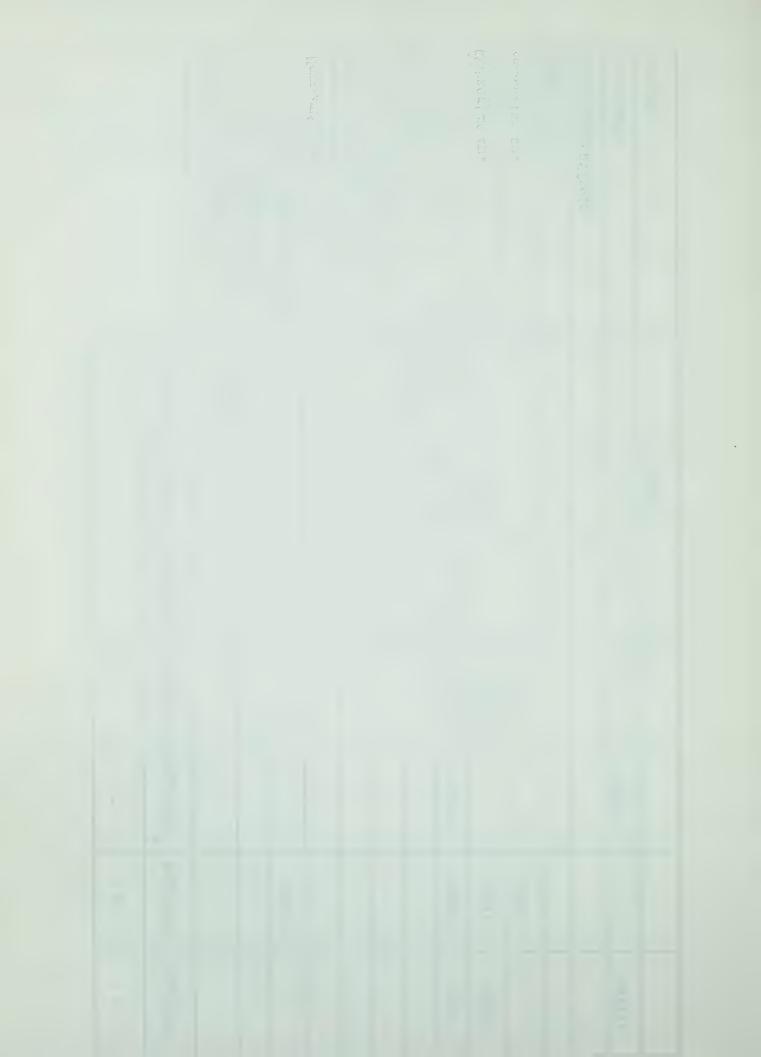


Station No.	Depth Ft.	Substrate	Location	Oil In * Substrate
1	15	Gravel - rubble	des Rochers R.	A
2	3	Sand - silt	des Rochers R.	A
3	8	Sand - silt	des Rochers R.	A
4	5	Sand - silt	des Rochers R.	A
5	4	Sand - silt	des Rochers R.	A
6	5	Sand - silt	Quatre Fourches	P
7	3	Sand - silt	Embarras R.	P
8	5	Sand - silt	Embarras R.	P
9	5	Sand - silt	Canoe Portage	P
10	5	Sand - silt	Canoe Portage	P
11	1	Sand	Fletcher Channel	A
12	10	Sand - debris	Fletcher Channel	P
13	2	Sand - debris	Athabasca River	P
14	4	Sand - debris	Athabasca River	P
15	2	Sand - silt	Big Point Channel	× P
16	4	Sand - debris	Big Point Channel	A
17	5	Sand - silt	Big Point Channel	A
18	6	Sand - silt	Big Point Channel	A
19	12	Sand - silt	Lake Athabasca	A
20	8	Sand - silt	Lake Athabasca	A
21	12	Silt	Lake Athabasca	A
22	10	Silt	Lake Athabasca	A
23	8	Silt	Lake Athabasca	A
24	9	Silt	Lake Athabasca	A
25	8	Silt	Lake Athabasca	A
26	9	Silt	Lake Athabasca	A
27	10	Silt	Lake Athabasca	A
28	8	Silt	Lake Athabasca	A
29	9	Silt	Lake Athabasca	A
30	7	Silt	Lake Athabasca	A
31	9	Silt	Lake Athabasca	A
32	9	Silt	Lake Athabasca	A
33	6	Sand - silt	Quatre Fourches	P
34	8	Silt - debris	Lake Athabasca	A
w TD	nyocont .	A = absent		

^{*} P - present; A - absent ** At mouth of Goose Island Channel

	Lio				
56.51.0			acod		
		7 O - 20 A			
	ř.				
	A				
		िल्ला			
	ç				
	r				
	Eq.				
	9 6				
		ra.			
	A				
		14:208/nf.	· · · · · · · · · · · · · · · · · · ·	01 -5 Cm	
		Portudad3:4	29.20°		
	A				

Pontoporeia affinis Oligochaeta		Lamsilis sp.	Husculium sp.	Sphaerium sp. 1(12)	Chironomidae 2(25)	Corixidae 1(3)	Baeitidae: Baetis sp.	Ametropidae: Ametropus sp.	Hexagenia sp.	Psychomyiidae: Polycentropus sp.	Leptoceridae: Athripsodes sp. 1(3)	Hydropschidae Hydropsyche sp. 36(94)	No _• (%)/ft ² No _• (%)/ft ²	1 2
					5(100)								2 No.(%)/ft ²	w
			2(2)	84(87)	10(10)									η
	9(75)				3(25)								No.(%)/ft ² No.(%)/ft ² No.(%)/ft ² No.(%)/ft ²	V
			1(20)	1(20)	2(40)					1(20)			No.(%)/ft ²	6
	22 (73)			6(20)	2(6)								No.(%)/ft ²	7

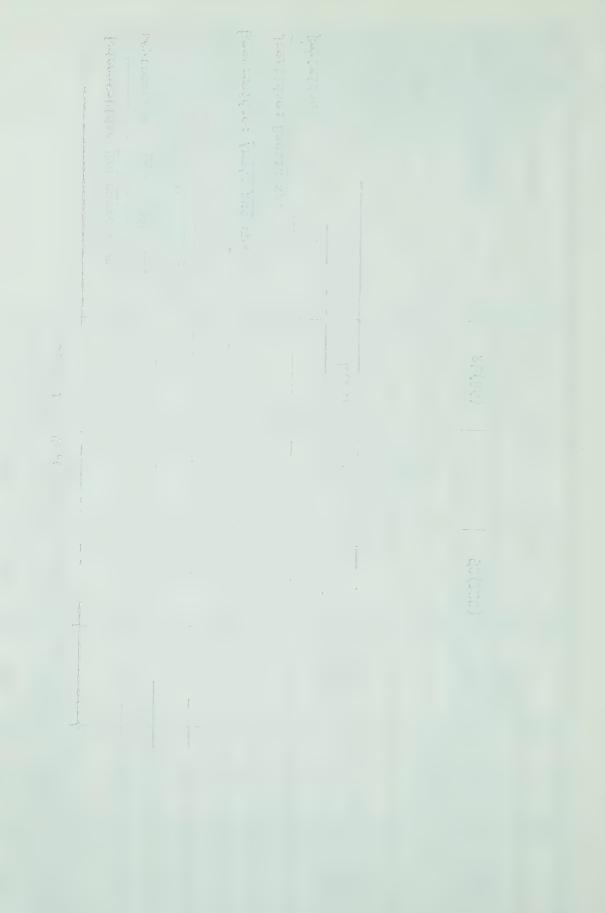


	Oligo	Ponto	Lamos	ະຳນອດເ	Sphaerium	Chirc	Corixidae	Baeit	Ametr	Hexagenia	Psych	Lepto	Hy-dro		
Fish fry	Cligochaeta	Pontoporeia affinis	Lamosilis sp.	hisculium sp.	erium sp.	Chironomidae	cidae	Baeitidae: Baetis sp.	Ametropidae: Ametropus sp.	enia sp.	Psychonyiidae: Polycentropus sp.	Leptoceridae: Athripsodes sp.	Hydropschidae Hydropsyche sp.		
	13(65)					1(5)				5(25)	1(5)			No.(%)/ft ²	œ
	16(94)					1(5)								No.(%)/ft ²	9
									1(100)					No.(%)/ft ²	OT
	22 (100)													No.(%)/ft ²	11
						1(50)		1(50)						No.(%)/ft2 No.(%)/ft2	12
	30 (100)													No.(%)/ft2	13
	96(99)									1(1)				No.(%)/ft ²	11

Fish fry	Oligochaeta	Pontoporeia affinis	Lamosilis sp.	Musculium sp.	Sphaerium sp.	Chironomidae	Corixidae	Baeitidae: Baetis sp.	Ametropidae: Ametropus sp.	Hexarenia sp.	Psychomyiidae: Polycentropus	Leptoceridae: Athripsodes	Hydropschidae Hydropsyche			
									• ds		tropus sp.	des sp.	che sp.			
	2 (100)													No.(%)/ft ²	15	
					29(88)					h(22)				No.(%)/ft ²	16	
	12(100)													No.(%)/ft ²	17	
														No.(%)/ft ²	18	
	8(5)	(88) المالة		12(7)										No.(%)/ft ²	19	
		28(87)		h(13)										No.(%)/ft ²	20	
	4(3)	120(86)				12(9)				4(3)				No.(%)/ft ²	21	

Enchon the factorial and the f

12	3	<u>चित्र</u>	[t-1]		S S	유	Co	U Q	Am	E e	· , 8	Le	4		
Fish fry	Oligochaeta	Pontoporeia affinis	Lampsilis sp.	jusculium sp.	Sphaerium sp.	Chironomidae	Corixidae	Baeitidae: Baetis sp.	Ametropidae: Ametropus sp.	Hexagenia sp.	Psychomyiidae: Polycentropus sp.	Leptoceridae: Athripsodes sp.	Hydropschidae Hydropsyche sp.		
		24(86)				4(14)								No.(%)/ft ²	22
				4(25)		. 8(50)				1(25)				No.(%)/ft ²	23
		52 (100)												No.(%)/ft ²	24
	(1)	272 (89)				28(9)								No.(%)/ft ²	25
		1(50)	4(50)											No.(%)/ft2	26
		236(94)				16(6)								No.(%)/ft ²	27
		(001)8												No.(%)/ft ²	28



	29	30	31	32	W	314
	No.(%)/ft2	No.(%)/ft2 No.(%)/ft2	No.(%)/ft ²	No.(%)/ft ²	No.(%)/ft ² No.(%)/ft ²	No.(%)/ft2
Hydropschidae Hydropsyche sp.						
Leptoceridae: Athripsodes sp.			-			
Psychomyiidae: Polycentropus sp.						
Hexagenia sp.						
Ametropidae: Ametropus sp.						
Baeitidae: Baetis sp.						
Corixidae						
Chironomidae	կ(2)			8(4)		12(43)
Sphaerium sp.						
insculium sp.						
Larmsilis sp.						
Pontoporeia affinis	220(96)	148(100)	192(100)	172(92)		
Oligochaeta	4(2)			8(4)	16(100)	16(57)
Fish fry			,			

	Sational technologies.	Echnolis en . American	
		SECTION IN AMERICAN SP.	
22 / (%) O23			
10° (8)			
			3
5			





WATER RESOURCES DIVISION

REPORT REGARDING OIL PIPELINE RUPTURE

GREAT CANADIAN OIL SANDS LTD.

R. E. BAILEY, P. ENG.

DIRECTOR OF WATER RESOURCES

R. ER BANKEY, P. ENS.

GREAT CANADIAN OIL SANDS LTD.

OIL PIPELINE RUPTURE

AND

ATHABASCA RIVER

Activity

The Water Resources Division did not take an active part in the investigations and "clean-up" operations arising out of the Great Canadian Oil Sand oil pipeline break and ensuing oil spill into the Athabasca River, other than to be prepared to lend assistance if called upon to do so.

Sufficient forces and expertise were available from agencies most immediately concerned and no additional assistance was requested from the Water Resources Division.

An aerial inspection of the pipeline and the Athabasca River was made about the time that clean-up operations were being completed.

Responsibility

In keeping with the intent and purpose of the Water Resources

Act, the Division approves pipeline watercourse crossings with terms

and conditions as may be required to insure safety to the pipeline from

damage or rupture arising from such erosion causes as flood, or ice action.

Only that portion of the pipeline as may be contained in the watercourse

channel has been considered.

Since the G.C.O.S. pipeline break occured at a location other than a river crossing, the Water Resources Division had not been previously

OTHER COMMENTS OF STATES AND STATES

alla

MUNICIPAL REVER

The Mate inner tree "Information of the second section of the second section and the second section of the Orest Canadian Oll Pear is the film of the collection of the film of the section of the sectio

Sufficient scent and vertils were satisfied into agencies and contact the state of the state of

deselant prior etem continue po l'ant l'ant va some don son

in it is to the second

In kerming run the lots of and purpose of the Varer Resources.

Are, the Division approve of north maters urst erastings with terms and conditions as may no required to insure safety to the pipeline from themeter or repture arm ing from such exerten causes as flood, or ice estimates from that portion of the pipeline as may be contained in the attendors.

The second of the second of the second of

involved in that particular section of line.

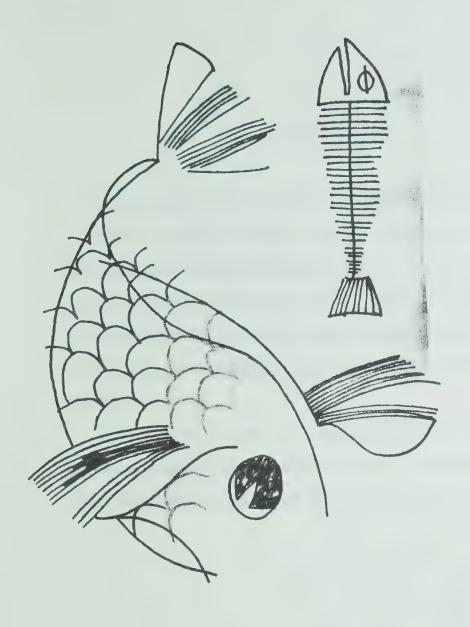
Future Prevention

Although the Water Resources Division does not have direct administrative responsibility for water pollution control, it does have an interest and moral responsibility as do various other agencies of government. It is appropriate therefore that the Division should undertake any measures that come under its jurisdiction which will assist in any pollution control objectives. Accordingly consideration is being given, jointly with the Pipeline Division of the Department of Mines and Minerals, to the introduction of additional safeguards with respect to pipelines located adjacent to water bodies.

Although the Water Resources Division does not have dishing two responsibility for Water politician control it rest and morel responsibility as do various other agencies of Severnment. Is appropriate therefore that the Division should understake any necesses that owne under its judisdiction which will assume political control objectives. Accordingly considerates any polition the Division of the Department street, in the interfunction of additional sateguards in presented adjace.







ENVIRONMENTAL HEALTH SERVICES DIVISION GOVERNMENT OF THE PROVINCE OF ALBERTA DEPARTMENT OF HEALTH

ATHABASCA RIVER OIL SPILL

DEPARTMEN ALBERTA

JUNE 1970



SUMMARY

This report outlines the observations and activities undertaken by the Water Pollution Control Section during the duration of the oil spill from Great Canadian Oil Sands Ltd. into the Athabasca River during the period of June 8th to June 18th, 1970. A further inspection of the Athabasca River Delta and Lake Athabasca indicates that the oil has virtually been dissipated and no immediate problems seem to be apparent.

A contingency plan is also presented which strongly indicates that an agreement between members of the oil industry be undertaken to assist each other in the event of any major hazard to the environment.

E. E. Kupchanko, P. Eng., Head, Water Pollution Control Section

June 30, 1970

MAMBUE

This reports callines the ornewestions and activities propriates by the lister Pollucion Consists Dection (acting the intestion of the lister Pollucion Consists Oil Sands Ltd. into the Corresponding Propriate Consists Oil Sands Ltd. into the Corresponding Propriate Oil June State June 18th to June 18th 1970. A current name of the Atheresea Educa Belts and Lad Cotacons or calcates which and have the actions of the Atheresea Cotacons and the actions of the Atheresea Cotacons and the Athereseat.

A contingency plan is the presented hiel trooping edicates to the an agreement between someons of the an agreement between the trooping major may major maker other II the event of may major maker other II the event of the contents.

3. 7. Tupel . 7. . Herd dator Pollhilen Control Securen

INDEX

Field Investigations	1
Reflections and Comments on the Athabasca Oil Spill with Respect to Future Development	8
Annendix	16

Place Tamenthallons.

Appropriate and Comment of the Special action of the Clark and a comment of the C

FIELD INVESTIGATIONS

INTRODUCTION

An investigation of an oil spill near the Great Canadian Oil Sands plant at Tar Island was carried out during the period of June 8 - 18, 1970 and on June 25, 1970. The oil spill was due to a 32-inch longitudinal rupture in a 16-inch products line which carries synthetic crude from the plant to Edmonton, Alberta. The location of the break which occurred on the afternoon of June 6, 1970 was approximately one-half mile south of the plant tailings pond and approximately one-half mile from the river. This report summarizes the observations made on the river during this investigation.

OBSERVATIONS

An aerial survey of the river was made in the afternoon of June 8, 1970 (Figure 1). Between Tar Island and Fort McKay, an oil-water emulsion could be observed in a thin string along the west side of the river with some accumulation of oil in back waters. From Fort McKay to Bitumount, approximately 50 percent of the water surface was covered with an iridescent sheen. A greater quantity of oil-water emulsion could be seen, which varied in width from 10 to 30 feet from the west bank. The area between Bitumount and Embarras showed a dispersion of the iridescent film across the entire width of the water. The emulsion remained along the west bank in a string less than 10 feet wide. The emulsion could not be observed near Embarras. The leading front of the oil film was just downstream from Embarras.

resident of en all apilians the appears and leading as the series is a series out final title appears and a series out final title appears and a series out final wing a series of a series of a series of the wing a series of the lace of the lace of the appears as a series of the appears of t

As cords: survey of the plant was

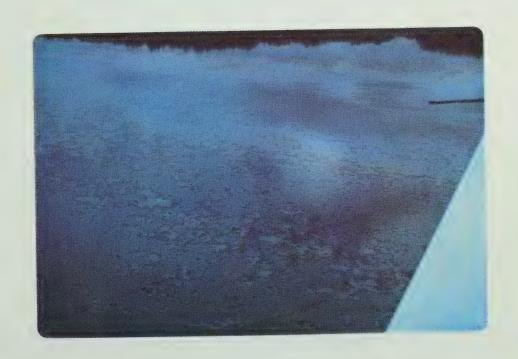
11. interest Tailer as

2 conserved in a thin string army

2 same of the circumstance of the circumstance of oil in their waters. It is not for which and the distinct of the course of the course of the antidese of the course of the c

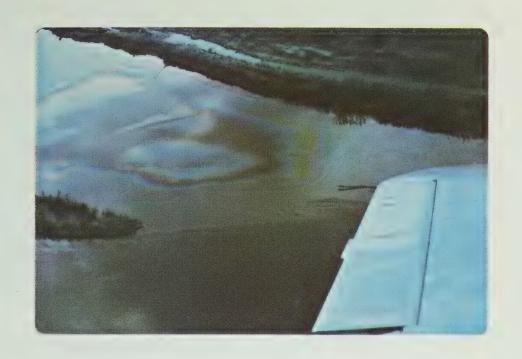


AERIAL VIEW OF BOOM NEAR TAR ISLAND - JUNE 8, 1970

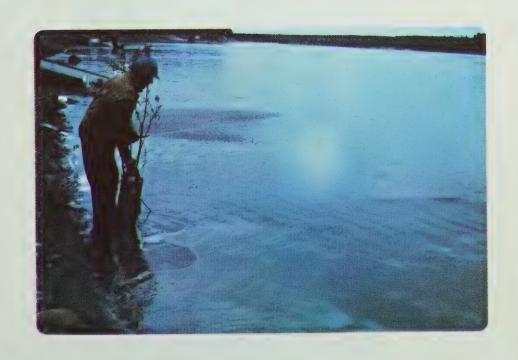


AERIAL VIEW OF ATHABASCA RIVER SHOWING IRIDESCENT SHEEN — JUNE 8, 1970





IRIDESCENCE ON THE ATHABASCA RIVER - JUNE 8, 1970

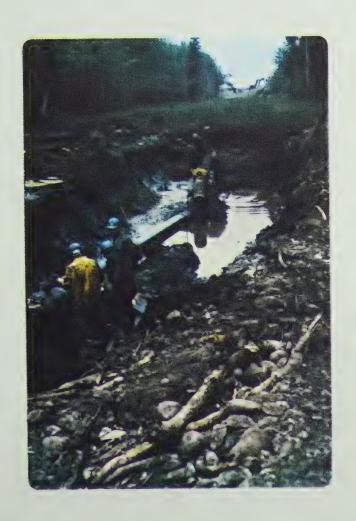


CLEAN-UP OPERATION AT FT. McKAY — JUNE 9, 1970 DISPERSANT BEING USED ON WEST SHORE





AERIAL VIEW OF PIPELINE RUPTURE AREA - JUNE 8, 1970



VIEW SHOWING PIPELINE - JUNE 9, 1970



A ground survey of the river at Fort McKay was made on June 9, 1970. Two crews were engaged in dispersing the emulsion, oil film and and small pockets of accumulated oil along the river bank. The emulsion lay in a very thin broken line along the west bank from which the iridescent sheen spread out for approximately 30 feet.

A program to determine the effectiveness of Corexit 7664 was initiated. An area of the river downstream from Fort McKay was aerial sprayed with this chemical with two loads of 1,800 pounds each, containing 6 percent Corexit 7664. The location where the pipeline rupture occurred was also inspected during the day.

A meeting was held with Mr. A. Boggs of the Fish and Wildlife Division on June 10, 1970. He stated that the oil film could be seen for approximately 100 miles starting from five miles below Fort McKay. He reported sighting oil emulsion extending 10 to 25 feet from the west river bank. He also reported having to kill a beaver which was covered in oil and appeared to be in distress. Mr. Boggs' observations were made from a boat on June 8th and 9th, 1970.

Observations were again conducted from the air in the afternoon of June 10, 1970. During this flight, the iridescent film of oil was seen to be spotty downstream of Fort McKay to a point near Ells River confluence. Here a definite increase in the amount of oil film could be seen with very little evidence of emulsion or oil accumulation. First sign of emulsion was observed five miles downstream of Bitumount. The emulsion along the west bank was in a thin discontinuous string. The opposite bank was clear of emulsion. Near the confluence of the Firebag

early est the river of Port Mally were must us dura ?.

1970. For er was enjaged to discount the deviation, all fills and as malk pook of second lates of a large the street court. The constraint lay to a very thin broken line along the west turn from Adah to. Indeed enter spread out for approximately institute.

A program to deterrine the officences of Cesavit "Co was initiated, An area of the river domained from our Makey. Attains of the river domained from our Makey. Attains the contract of the formation of a domain of percent Corexit Tible. The location or are an other.

A meeting was held with Mr. A. Borga on the struct 11 mid no seek 10 approximately 100 miles startly countity to be law to ye is neported sighting oit evaluation rates that if the lest In the startly contact sighting oit evaluation rates that if the lest In the start reported boots on the law to be in the start reported boots of the start reported to be in district. One observations were and from a boots on lune 8th and 9th, 1970.

Observations were again conducted from the mix in the efferences.

June 10, 1970. During this flight, the iridescent full of mil was sen to be spotty domestream of Fort Maley to a point were fille lives.

Here a leftmite inverse in the amount of oil file coald

deeth one of the second of the

a did a the some the some

Piver, a continuous sheen was observed throughout the width of the river. Pockets of oil and emulsion could be seen on the east bank. On the west side of the river, emulsion could be seen extending three feet from the bank. The width of the emulsion increased to 30 feet near Embarras, then decreased to a narrow string and completely dissipated near the 28th baseline.

A meeting was held with Great Canadian Oil Sands officials on June 11, 1970 to formulate a method to contain the oil and emulsified oil from reaching Lake Athabasca. It was agreed to remove the emulsified oil from the west bank of the river and remove all free oil accumulation in back waters. Great Canadian Oil Sands stated that all necessary men and equipment would be moved to the Embarras location to stage a two front attack. Two crews would advance downstream from Fort McKay while two other crews would be engaged working upstream from Embarras. To make this operation successful, both chemical and mechanical methods would be used.

Another air surveillance of the river was made on the morning of June 12, 1970. Near Bitumount, a slight iridescence was observed. Emulsion was not noted until the point near the confluence of the Firebag River was reached. A ground level examination of the emulsion and the iridescent sheen was made near Embarras. The strings of emulsion were one quarter inch in thickness and broke up into globules when scooped up into the hand. The sheen which could be observed from the air was barely visible at water level. The amount of emulsion increased near Embarras Portage extending 20 feet from the north shore. Emulsion was also prevalent on the south

i and employed the neet on the meet back. On the work

of the river, employed to each tradescrip, there foot from that

to The width of the employed the accorded to 10 feet mean "microse their

to a confirmation there and the finite of the theory of the test of the the the the test of the the test of the

A reserve was held with Great Cementer the oil sands of the district of the collection of the collecti

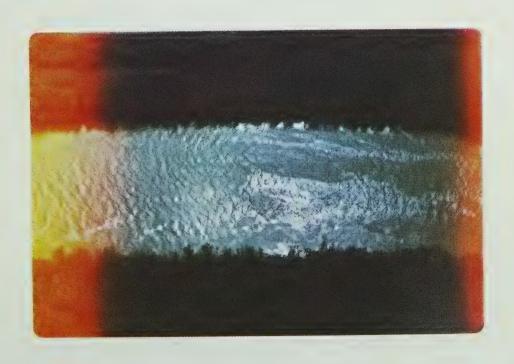
Another eir murrell'ence of the fivet was more of the pareing of

June 12, 1970. Here Elitation is alight instructed the inches the firebox line of the firebox line on the firebox line of the inches the confidence of the inches the confidence of the information of the information of the information.

11 SEA 2015 3011



OIL-WATER EMULSION IN ATHABASCA RIVER AT EMBARRAS — JUNE 16, 1970



OIL-WATER EMULSION IN BIG POINT CHANNEL AT BIG POINT - JUNE 16, 1970



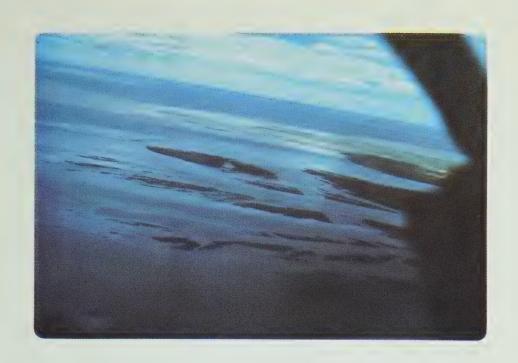


MOUTH OF BIG POINT CHANNEL AT LAKE ATHABASCA
JUNE 16, 1970

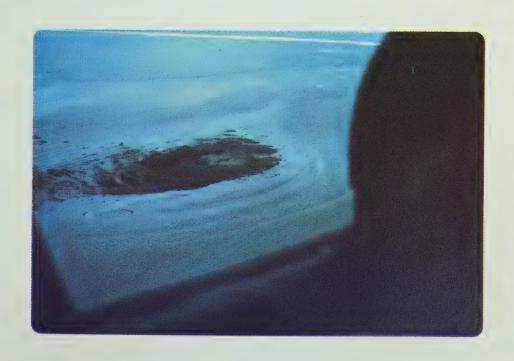


IRIDESCENCE OIL FILM ON DELTA SHORE LINE JUNE 16, 1970





LAKE ATHABASCA AND DELTA SHORE LINE JUNE 16, 1970



LAKE ATHABASCA — JUNE 16, 1970



bank with some accumulation of free oil in back waters. Free oil was observed in eddies approximately five miles downstream from Embarras Portage. The largest of the three oil patches was approximately 20 feet by 30 feet and one quarter to one-half inch in thickness. A survey of the main channels in the Delta area was also made. The film of oil had advanced to near the mouth of Fletcher and Big Point Channels but not into the lake itself. During this survey it appeared that the oil would be contained in the main channels of the Delta region.

One June 15th, Mr. Bland of G.C.O.S. stated that he had inspected the Athabasca River by motor boat on June 13th and did not detect any traces of oil or oil-water emulsion as far as 40 miles downstream of Tar Island.

An aerial survey of the Athabasca River between Fort McMurray and Lake Athabasca was conducted during the afternoon of June 16, 1970. First observations of the emulsion in the Athabasca River were sighted just north of the confluence of the Firebag River. From this point northwards to Portage, the emulsion occupied approximately 5% of the water surface coverage and was intermittently scattered along the Athabasca River in twisting formations ranging from 50 to 200 feet in length and varying 10 to 20 feet in width. Free oil was not observed.

In surveying the Embarass River, Fletcher Channel and Big Point Channel in the Delta area, it was noticed that the emulsion strips covered approximately 25% of the water surface. Small patches (20 feet by 2 feet) of iridescent oil film were scattered along the banks of these rivers near their mouths to Lake Athabasca. Very slight iridescence was observed on the calm shore waters of Lake Athabasca in an area north of the Delta and

a 6

and in addicate the cores of the miles tomorrows for intermediate tomorrows for intermediate tomorrows for intermediate tomorrows of the tomor

Def : It til the med at the rest to find and the sense of the sense of

Letternit wher end Ri seminisce of

the Arbertana styre my dran make a June 12 are selected at the Arbertana styre my drank and June 12 are selected at the party of the pa

As coming nature, of the asperance of the content o

receipt the Palminer Elver, Elected Chapped and July 2013

on that the man notified that the man parties of the control of the

between the mouths of the Embarras River and Big Point Channel. Iridescence was not evident in the main of Lake Athabasca north of the Delta where windy squalls and wave motions prevailed. A light iridescent film (500 feet by 20 feet) was observed fanning out into the northeast tributary leading to Richardson Lake. However, a surface boom had been installed below the 28th Base Line to contain free oil and the emulsion in Big Point Channel from spreading into Lake Richardson.

In Fort Chipewyan, a meeting was held with Mr. D. Steven of the Canadian Wildlife Services who indicated that:

- (1) a boom was being constructed to prevent the flow of oil into Des Rochers River;
- (2) application of emulsifiers to Lake Athabasca was discontinued because of potential secondary effects and the oil appeared to have been dispersed by wind action;
- (3) biological studies on aquatic life were being initiated to determine long term effects;
- (4) a "slick licker" barge was being evaluated to determine its capability in the mop-up operations.

Surface water samples were obtained from the Athabasca River, the Delta channels, and Lake Athabasca by officers of the Department of Lands and Forests on June 8-9, 1970. The concentration of oil and grease ranged from 1.8 mg/l downstream of Tar Island to 12.8 mg/l at Mills Island (Figure 2). No oil was visible in these samples.

River water samples collected between McDermott Island and Chipewyan I.R. contained a 1/8" - 1/2" oil layer on top. Considerable suspended solids were evident in the samples. It is assumed that oil

absent the mailth of the Subarran Blver and his rotal Champal. Imidose comes was not extremt in the main of lets Athahans north . . . Delk where whale whale and wave methods of the antited . . . Delk (500 feet by 20 feet by 20 feet was charren forming out then so northhaps triouses; landing to Michardenc Lake, Romewer, . where can use in the the below the details free oil out a sea in the the below the dealers of the chartes of the search of the contain free oil out a sea in the search of the contain free oil out a search of the contain free out a search of the cont

In Fort Chiponyan, " meeting was as alike in. ... 5777
Canadian Wildlife Services wh andicated tout!

- of linte Dee houses: Siver:
- the oll appeared on here can shared the oll appeared on here can shared
- (3) biological Blustes or outs'is the vers leitled to determine long werm off :
- (A) a "allo's licher" been ver being work made in loserribes

Survey water comples were obtained from the attached through the concentration of the imperchast of large at Forents on June 8-9, 1970. The concentration of oil and miceius of the concentration of t

.d. was vistole in these semples.

M non-ed betanfioe an

adhered to this sediment, thus giving high results ranging from 2500 mg/l to 713 mg/l at these respective locations (Figures 3 and 4).

Oil was not present in samples collected from the Athabasca River and Delta channels between Point Brule and Lake Athabasca on June 9, 1970. The concentration of oil and grease ranged from 2.0 mg/l at Point Brule to 0.3 mg/l at Lake Athabasca (Figures 4 and 5).

During the afternoon of June 17, 1970, sub-surface samples were collected with a Kemmerer sampler (Figure 6). The concentration of oil and grease ranged from 0.6 mg/l at Big Eddie Bend in the Fletcher Channel to 0.0 mg/l near Potato Island in Lake Athabasca. Intermittent formations of emulsion were observed in the Delta channels at up to 10% water surface coverage. The emulsion was noticeable at elevated heights but not at ground level.

On June 18, 1970 Mr. A. Galbraith of G.C.O.S. stated that mop-up operations were continuing in the vicinity of the ruptured pipeline. It was anticipated that clean-up operations in the Delta and Lake Athabasca would be completed by the weekend of June 20-21, 1970.

Mr. A. Boggs, Fish and Wildlife Officer, stated that no traces of emulsion or free oil were observed during a motor boat inspection of the Athabasca Fiver from Fort McMurray up to Lake Athabasca at Fort Chipewyan on June 20-21, 1970.

An aerial survey of the Athabasca River, Delta and Lake Athabasca was conducted on June 25, 1970. Emulsion or oil was not evident in these bodies of water. All surface booms (Des Rochers River, Lake Richardson) were removed. A dike of straw bales had been constructed on the west bank of the Athabasca River near the site of the G.C.O.S. ruptured pipe line. This measure would prevent leeching of any residual oil or emulsion

tips 2520 mont gainer, crosses rates required from 2520 and .

uli was not present Ed sample of the condition to be brishades Hard.

and Delta channels between other record in an alless Athar and an Auna 9, 1970.

The concentration of the record in the analysis of Point Bruil of Point Bruil to 0.3 mail 1 lake there at the record in the concentration of the consentration of the consent

larion on the second of the se

Operations we seek that the management that the management and the management that the management and the management that the

Mer. A. Mayers, Ed. and dilitib offert, and the so tropes of semilation of five off were absented their poster best inspection of the Athebases Five fever levitarray on to late Athabases at Fort Chiprogram a runs 20-21.

In certal commay of the Asharance River, Delta and lake At

from the immediate area into the river by surface run-off or the fluctuating crest of the river.

Sub-surface water samples of the Athabasca River and Big Point Channel were obtained at Big Eddy and the south end of Tokyo Syne (Figure 7). Oil and grease concentrations were 1.1 mg/l and 0.6 mg/l at these respective locations. These analytical results are considered to be minimal. The aerial inspection of the Delta also indicated that the oil has virtually dissipated and no immediate problems seem to be apparent.

-คาเป้า ดที่เ รีย วิวิธ-ตะสา คอะโรกา หลี ระบาร อสส อปะป ดอกอ

savin ndi To f

Smart wir world acredents ed. to refunde today continue-dus.

sammer were chiained at lity form and the

(Figure 7), Oil and greens nonembrania and while har may

at these respective level as three and se

to be minimal. The ential imprenting

the oil has virtually dissipated and

REFLECTIONS AND COMMENTS ON THE ATHABASCA OIL SPILL WITH RESPECT TO FUTURE DEVELOPMENT

PREVENTION PLANS

The primary elements of any oil spillage are essentially -

- (1) Prevention of the oil spill
- (2) Control or limiting the consequences of the oil spill
- (3) Restoration of the shore face and waterfowls
- (4) Ecological effects

Pipelines and storage tanks should be designed, constructed, and tested according to established safety codes. Pipelines should be equipped with automatic shut-off valves that stop flow if a break in the pipelines occurs. Most refineries and loading terminals are equipped to handle relatively small spills. It cannot be emphasized too strongly that the best way to handle oil spills is to prevent their occurrence.

SURVEILLANCE AND PREDICTION OF SPILL BEHAVIOR

Aerial reconnaissance of oil spills is far superior to any surface based surveillance system. Large areas can be observed in relatively short periods of time, and the economics gained are significant. Many sophisticated techniques of surveillance are available and include photography, spectrophotometric, infra red, ultraviolet, radar and microwave imaging. It must be remembered that the higher level of sophistication requires skilled personnel for operation and data interpretation.

In general, the capability of oil slick behavior is not too well advanced largely due to the great number of variables involved (all time dependent).

Translate Survey

" 12 (AC. 1) (1)

The factor of the contraction of the second of the contraction of the

11754979

T this 231 92711

To time3

Fatty or at

Designation of the state of the

BULLET LIKE TO LET TO THE TOTAL PROPERTY OF THE PROPERTY OF TH

April next to the section of the sec

protestint, infra ret, of branchot, rater and micropave inaging. It with be protested that the bigher is so of acompanion requires the there's

I for speration and dama inverse thou.

brades weekle to to the sitch coherda

They to retain your -

The boundaries of oil spills in rivers and streams can be defined, however the relative emulsification rate cannot be predicted. Similarly, the amount of oil remaining in back waters and on the banks is difficult to predict.

In lakes, slicks will be affected most strongly by wind conditions and can be expected to move at a speed approximately two to four percent of wind velocity.

CHEMICAL TREATMENT

There are a number of compounds and materials available to treat oil slicks. Five classes of collecting agents are generally available for oil slick recovery. These are:

- (1) Floating substances such as Peat moss straw and sawdust.

 The floating substances are inexpensive and can readily be disposed by burning or burial.
- (2) Plastic materials such as polyurethane foam. The use of plastics and other similar materials are rather expensive.

 Oil can be reclaimed for subsequent use.
- (3) Gelling Agents. Gelling agents that solidify petroleum compounds are still in the development stage.
- is available, however very little quantitative or comparitative information exists. These materials may be toxic to aquatic life to some degree although several low toxicity dispersants are available. These dispersants break up the oil into particles of one to five micron size and expose a

The bourgaries of all stills a reverse set elecans can be defined, Asyover the relative smallstile. For the demonstration is a converse and on the banks is difficult to predict.

Sheet, like all corrected the prompty of white endlikes and con be amounted to be a more considered to be a more considered. The transfer of the contraction of what we have two

The A C . I

1817; do e ...

e the property and the property of

- a serious state of the colors of age.
- is suppleted to dispersable. A large namer of ileperated is employed, necessary little quantitative of properties of the estative information takens. These meterials may a seed

very large surface area of the oil to natural biological degredation. The low toxicity dispersants available include "Gulf 1009" & "COREXIT 7664" for dispersing crude oil and light fuels and "COREXIT 8666" for heavy fuels. The general conclusion after experience with a number of incidents such as the Torrey Canyon and the Arrow is against the general use of emulsifiers. In general, physical collection is preferred if possible.

(5) Absorbents. Numerous solid absorbents for sinking oil are available. Aquatic organisms may be affected adversely and resurfacing of the oil is possible although delayed in action.

BIOLOGICAL DEGREDATION OF OIL

Biological degredation of hydrocarbons in water is controlled by environmental conditions such as nutrients, temperature, oxygen availability, degree of dispersion of oil in water and micro-organisms present. Under fairly warm conditions, biological degradation can occur in a matter of days. However, this process is greatly decreased under cold weather conditions. Generally, degredation rates appear to be very slow.

PHYSICAL METHODS OF TREATMENT

There are generally three practical physical methods of oil slick recovery all interdependent on each other. These include -

- (1) Booming
- (2) Burning
- (3) Skimming

The person of the off the entropy of the entropy of the person of the degree of the tenter of the tenter of the second of the se

(A) Wheeler the control of the contr

10

Historical depredation is syntage that its controlled by enverous out to a controlled by enverous out to a controlled by ability, degree of discounted to an above outstand their fall by wire condition, bid all degrade controlled in a different controlled forms. However, this process is upen all correspondent cold writher conditions. Company the degrade appear to be very slow.

That when 30 septon I've

There were a ly topen of leaf physical strong of a seem of intender a sat on each others. These in lade -

Booming - Containment of oil spills can be effectively handled by using booms. The ability to confine a spill in the area immediately surrounding the source is principally a function of time, availability of equipment, and prevailing environmental conditions. There are two principal types of mechanical barriers applicable to oil spills: floating booms and underwater bubble barriers. Generally, both methods are suitable only for relatively calm water. The floating boom generally is more portable and involves less erection time. The disadvantage of the bubble barrier is the loss of contaminant in the event of air supply failure.

Different types of floating booms are: wood floats, logs, rubber floats (large diameter neoprene coated), canvas covered cork, chain-weighted boom suitable for permanent installation and plastic type boom. It is extremely important that the boom is readily available for quick placement, is light enough to be handled with limited manpower and can contain the oil in the area used even with strong currents and rough water. The plastic type of boom is probably most suitable because of its ease of storing and handling.

For any oil removal equipment to be effective, it must be modularized and capable of aerial transport and delivery within a short period of time.

The equipment must also be compatible. Experience has shown that booms from different manufacturers could not be joined together.

Burning - Burning on the water surface is generally not too effective due to rapid transfer of heat to the water. Burning of oil soaked straw or other materials may be effective. Burning of light fractions such as gasoline may be useful. Burning on the surface water, in lakes and streams is severely hampered by the lack of overall control and of the possibility of forest fires.

Surming - Barning on the water sur see is gonerally not on el ma

- x - - property and in a second and - x -

Skimming - Mechanical devices for collecting oil from the surface water such as suction pumps, rotating cylinders and belts are available, however the capacity of these units are relatively small. Their use is restricted to relatively calm waters or in areas where the oil layer is quite thick. Overall costs for removing of oil (from harbors) ranges from \$1.35 to \$3.00 per gallon.

RESTORATION

Physical removal of the contaminated material on the banks of streams and lakes with appropriate earth moving appears to offer the best solution. Addition of absorbing material such as straw, sawdust or clay can assist pickup. Plowing under is unsatisfactory because the water may ultimately cause resurfacing of the oil.

Detergent cleaning has been used in combination with mechanical filling.

It appears that physical removal with the assistance of absorbents as necessary and possibly backed up by limited use of detergents is the best method of restoration.

BIOLOGICAL AND ECOLOGICAL EFFECTS

Attempts to clean large numbers of oiled birds and animals are futile. Of the many thousands of oiled birds captured and treated following the Torrey Canyon incident, a small percentage recovered. Small concentrations of petroleum products and derivatives are toxic to aquatic organisms. Due to the diluting effects of the water, the concentrations that would be directly lethal to the aquatic organisms may not always be reached. There may be a number of subtile effects,

Stiry Bg - Morbouled devices for collecting of two subsets of the surface water such a. cuetion pures, reseting cylinders and best and evallering horever the case ity of these units are relatively small. Their use is restricted to relatively out these units or in also when the oil sever as quite thick, because out for reporter of the area when the oil sever as quite thick, becall out for reporter of the area when the cort for reporter of the stirk when the cort for reporter of the stirk when the cort for reporter of the cort for several cort.

M. MAIN HA

Physical remain. It the contemnation of the test of the partial remains in the rest of the streams and labers with any finitely a streams are also as a single of the content of the rest of the rest

Determine the number of anthropism of the cochanged filling.

It appears that objected memoral to the solutions of abnormance as abnormance as abnormance as the meconsulty and potted in by lim tell in of retements in the best matters of metometrics.

BIOLOGICAL OH DIVIS CAPACIE

Attempte to cloom lates uncorn of oiled birds and arisely ar fieldle. Of the mapy thousands of chied captured and treated fallowing the forcey of an indicant, a small process on a conjunt of colors of petrolomy products one de

however, that may escape the casual observer. These subtile changes may be more prominent during certain periods of the animals' life stages or when environmental conditions are marginal for survival. Tainting of aquatic organims especially fish may result. Such indirect effects warrant more detailed study before any catergorical statement can be made on the overall effect of aquatic organisms.

Oil pollution generally changes the species composition of bacteria present in the water so that forms utilizing petroleum as an energy source temporarily predominate.

Many detergents and demulsifiers are toxic to bacteria, protozoa and other microscopic organisms in the food chain. In some cases, their toxicity exceeds that of oil alone.

BIOLOGICAL AND CHEMICAL EVALUATION

Both the Fish and Wildlife Division of the Department of Lands and Forests and the Environmental Health Division share a mutual concern for surface water quality and the potential hazard of pollutants affecting the ecological balance of the natural environment. The Fish and Wildlife Division represents expertise in several phases of freshwater and wildlife ecology, physiology, and toxicology. The assessment of the environmental requirements for aquatic life and wildlife and the determination of environmental concentrations of potential toxicants that are not harmful under long-term exposure are areas that are investigated by the Environmental Health Division. Surveillance of an oil spill incident involves prediction of the behaviour of the spill and evaluation of the effectiveness of the clean-up operations. The immediate short-term effects of an accidental

Bosever, that may escape the commal chearver, Tacco cubbils anances may be note promised during certain periods of the annuals! His stages or uben controlled during series are marking for survival. Parating of countrolled controlly than may result, but indirect effects warrant more detailed study here we any coherentical statement can is made on the oversil effect.

Oil poliution renerging has the professormerities of beerering present in the 28 or 58 or 50 or

Many delor-catts constants and other microscopic rectar.

In the constant rectar of the constant of the consta

A 1 0.7015

Both the 1sh : 1:11 in major a condern for Peressa end the Darthawenn Med c : m s : n : major and for entire entire with mining end the porend : sound : nature and said affects the ecological halm on on the contrast : the Flab and William Division represents expective in several possess of freehunter and wildings ecology, physiclosy, tention only. The evacuation of the environmental reconstructions for equation 11% and wildings and the environmental mental concentrations of potential concentrations of potential contentration of environmental mental concentrations of potential contentration and the date minution of engineers that are not : minution of engineers.

Thems:

oil spill on water fowl, fish, beaver, etc. can be objectively evaluated. For example, oil can cause tainting of fish or edible invertebrates. Oil sludge deposits on the shores or bottom of the receiving body of water may become effective toxicants to sensitive benthic organisms. Depending on the extent and magnitude of the oil spill, the ecological deviation may or may not be immediately apparent. However, stabilization of the ecological balance in the contaminated body of water will occur after sufficient time has elapsed to allow biological activity to recover to normal. The chemical analyses of water samples performed by the Environmental Health Division and the biological data and long-term studies of aquatic life and fauna by the Fish and Wildlife Division serve to complement one another. A policy of strong liaison between the two departments exists to this extent and this greatly assists in providing a basis for comprehensive evaluation of any water pollution problem.

CONTINGENCY PLANNING

Contingency planning for coping with major oil and hazardous chemical spills should be undertaken with a systematic approach. Planning should be focused on specific geographical locations in relation to river basins and navigable lakes. The contingency planning should be directed specifically at -

- (1) Providing an estimate of accident probability including severity location and path of pollutant.
- (2) Reviewing sectors of the economy and resources that might be affected and how these might dictate or restrict control methods.

all apill on water 2000, tied convent and a rejectively evaluated.

For concepts, all one considers of the constitute course of miser and becomes offered to the concept of the considers of the concepts. Classified and becomes offered to the concepts of the constitute of the execution of the execution of the execution of the equipment of the context of the context

Unclin every pinners, for severy used as the as appropriate bound of the chemical sections and the should not smooth the species of the characters of the contract of the characters of the char

⁽M) Provinted on enthance of adulton probability inc

- (3) Establish where necessary a warning and communication network to be activated in the event of an emergency including an inventory of equipment and supplies and their sources, and sources of real-time environmental data that may be required in the event of an emergency.
- (4) Provide for a rational basis for stockpiling control of restoration equipment and materials (and by what agency).
- (5) Establishing specific plans of action for selected situations of higher estimated probability and severity.
- (6) Identifying significant control measures that must be taken in advance.

It is recommended that an agreement between members of the oil industry in Alberta be made that in the event of a fire, spill release or other emergency which endangers the environment, the companies will assist each other by providing the available materials, equipment and manpower to deal with the situation.

Any party to this agreement responsible for the occurrence will be responsible and pay for the cost of equipment and material provided by the other parties used in combatting the emergency. If the responsibility for the emergency cannot be ascertained, then each of the parties will share the cost of the equipment.

A. Masuda, P. Eng.

P. Shewchuk, P. Eng. Water Pollution Control Section Assertion to be entirely in the even or as considered to the early representation of the last of the early of early of early of all and engineers and the early of ea

Any nest to this accordant consumers one promotenes will be respondible to the combetting the numerous of the respondibility for the emergency. If the respondibility for the emergency of the narties will obtain

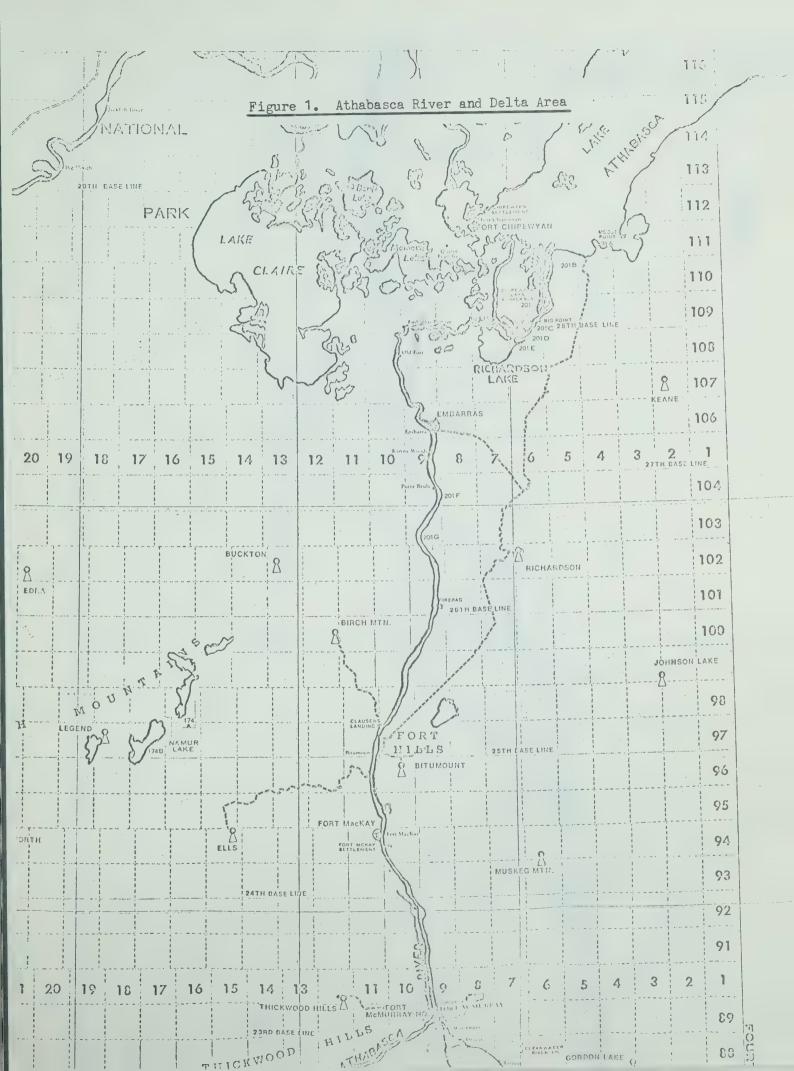
APPENDIX

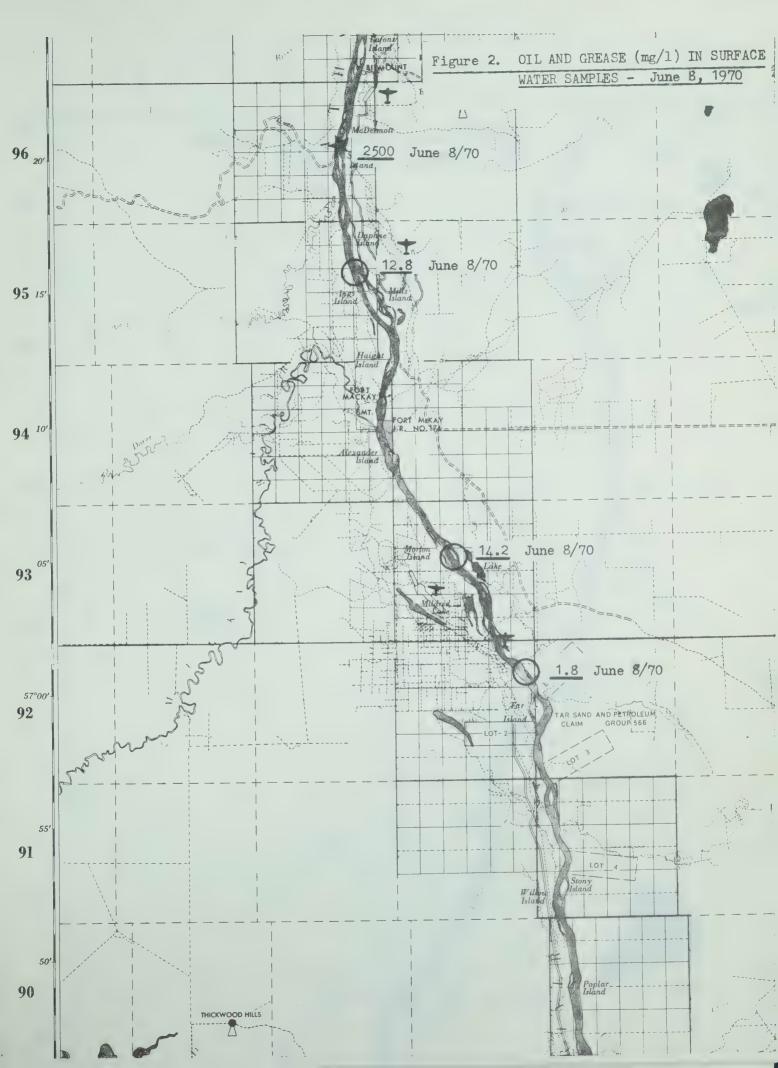


FIELD SURVEILLANCE OF ATHABASCA RIVER

AND DELTA AREA



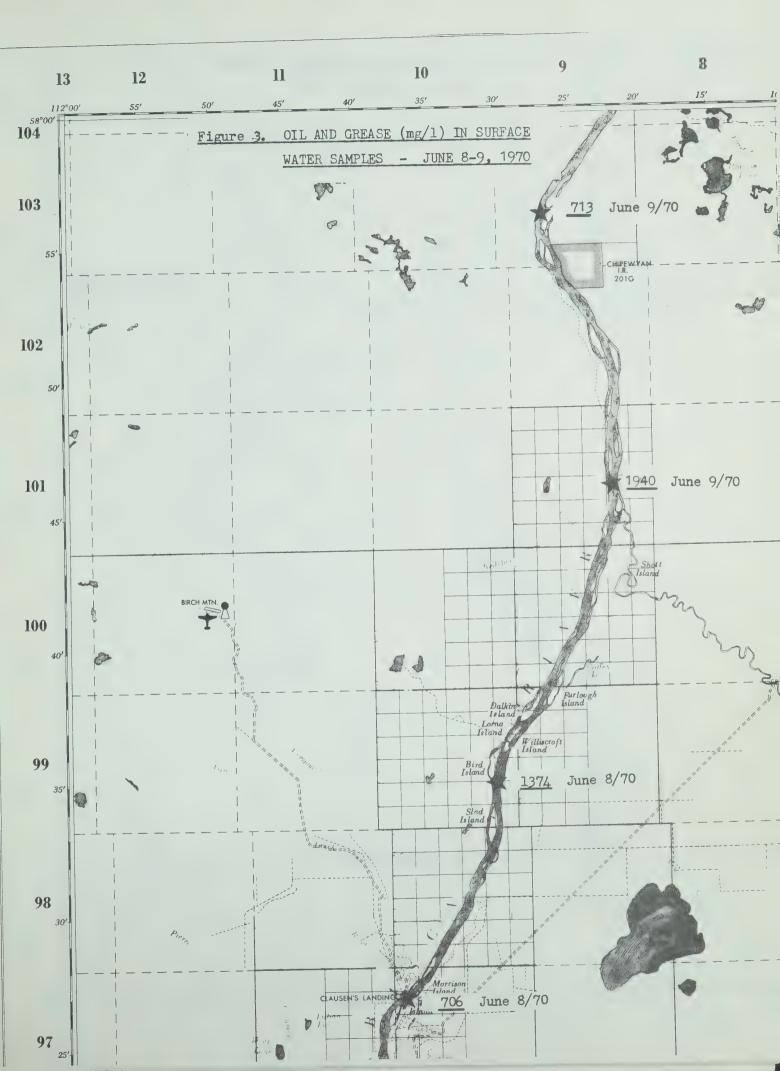


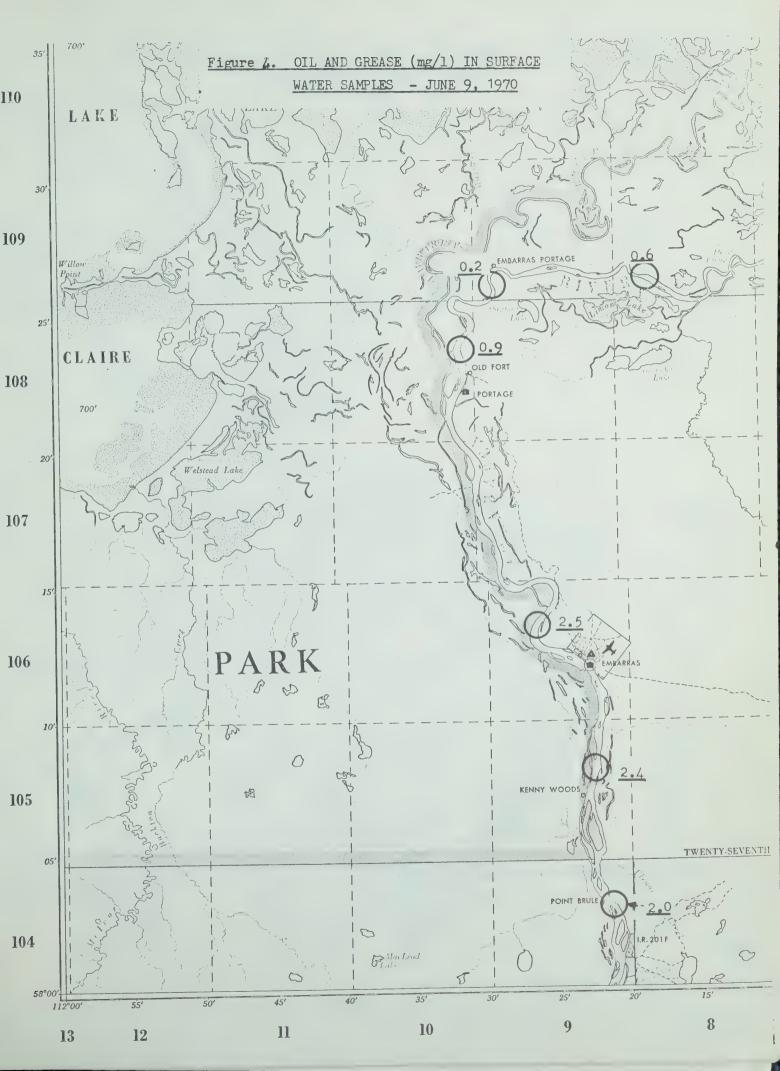


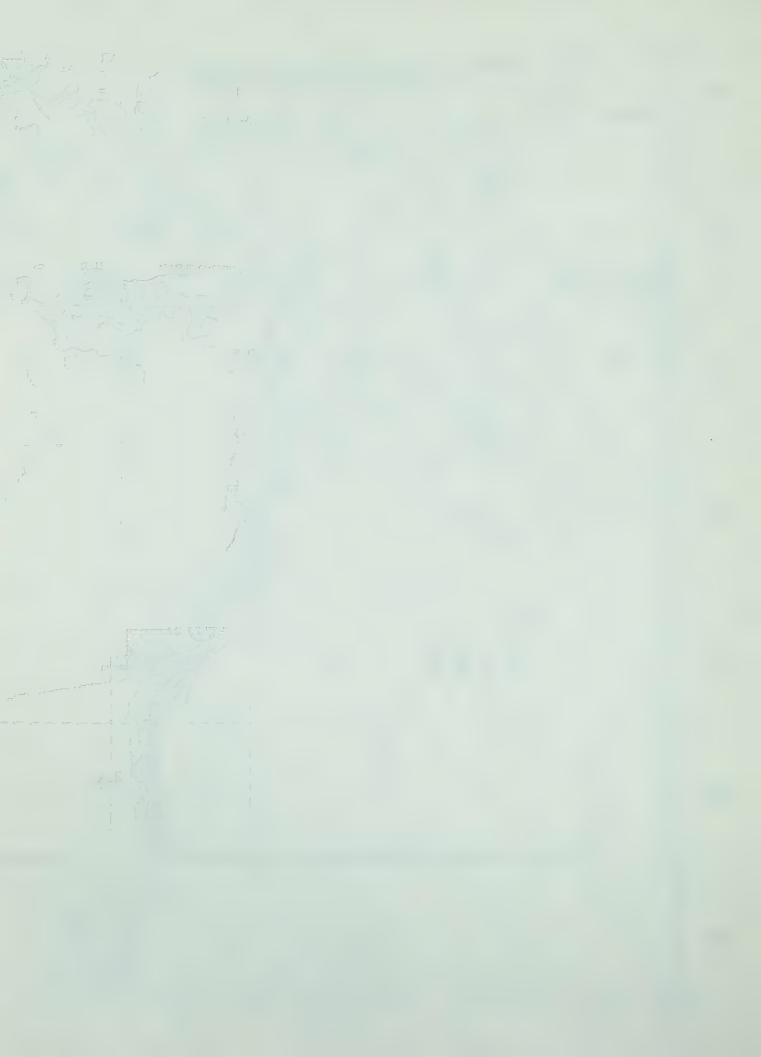
c 5

ę

Continue of the

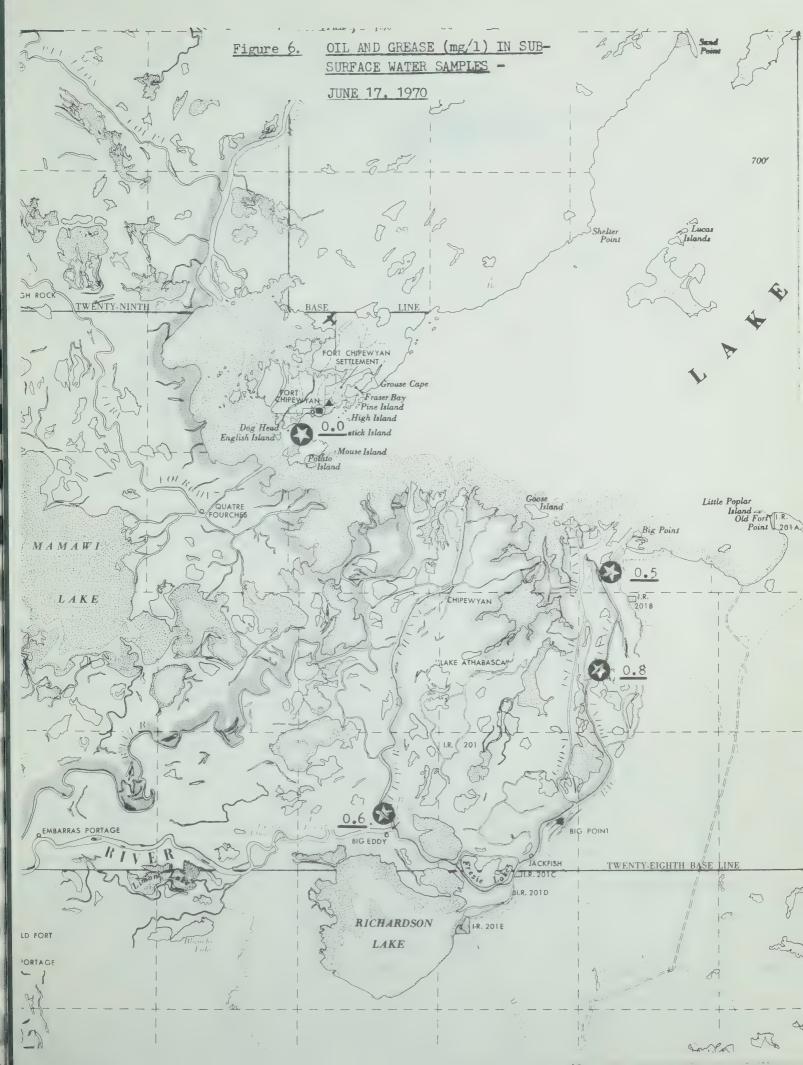




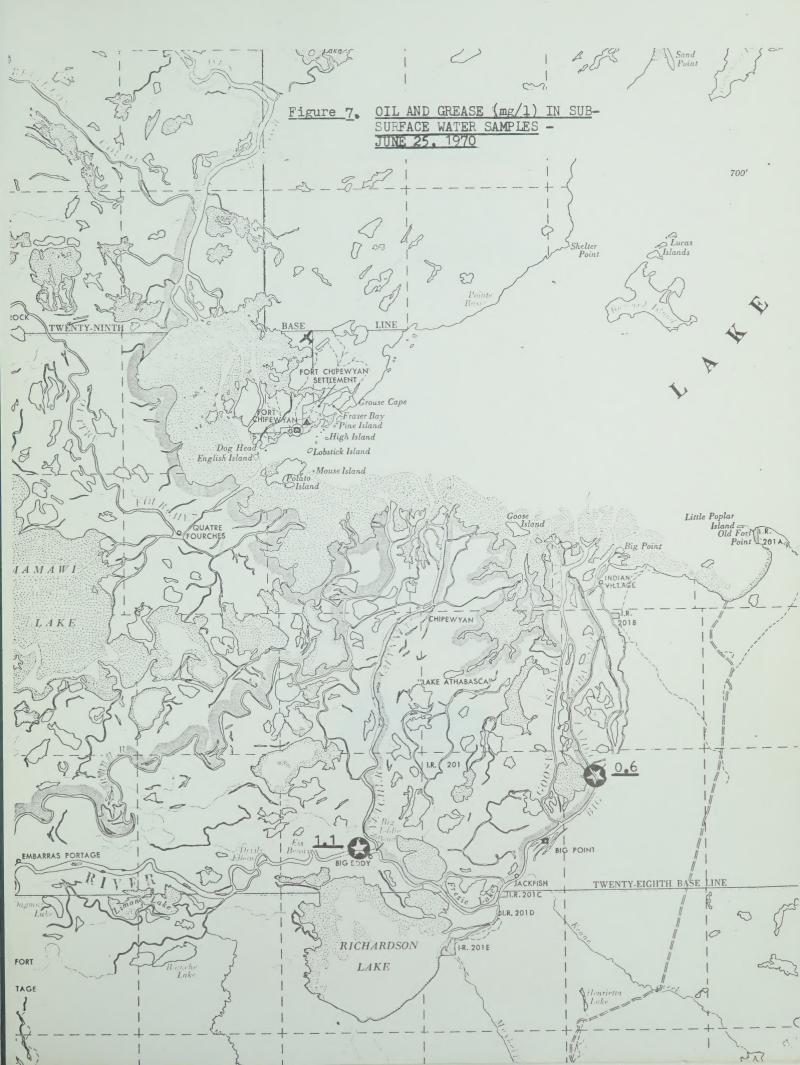




CONTROL OF THE SEASE CONTROL OF STREET



Cheni Chi III III di senti



Alberta Government Committee Report on Great Canadian Oil Sands Oil spill to Athabasca River

.*.

CA2ALZ 3 - 70G01



